# ELECTRICAL REVIEW

[ILLUSTRATED]

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**The Edison Central Station System.**

When, in 1879, Mr. Edison entered the field of incandescent lighting, three difficulties confronted him: The production of currents of low electromotive force by machines of sufficient capacity to serve as factors in a center of supply for the light of a town or city; such distribution of these currents as to make it possible to utilize them in any locality within the district covered by the conductors, and in minutely subdivided quantities, without disastrous loss; and lastly, the construction of a lamp which should combine the essentials of cheapness of first cost, economy in consumption of current, and long life. These obstacles have been so far overcome that towns and cities are now lighted with the same facility as with gas, and in some cases at a lower actual cost for a given amount of illumination.

It is by no means the purpose of this article to slight the industry or achievements of any in the incandescent field. Other filament lamps now in common use in Europe are doing good work in mills and other isolated installations. We note here only the recent progress in what may be distinctively called "central station distribution," which opens, of course, by far the largest field for illumination of any kind—interior spaces, and particularly stores and dwellings, where, by reason of its superior steadiness, softness, and economy, the incandescent lamp must ever hold an undoubted advantage.

When we consider the absorbing interest which is felt in this whole subject, it is surprising to see how little definite information regarding its details is possessed even by practical electricians. Certainly very few have any conception of the methods pursued in the New York station, the initial experimental ground, where to-day may be seen the demonstration on a large scale of the hypotheses of two years ago. Since the starting of the rapidly revolving armatures on the 4th of September, 1882, only one interruption has ever occurred, and that but for a few hours, proving the reliability of the service when properly inaugurated and administered.

But Mr. Edison has not been satisfied with the success of his first plans. The conductors were too large and costly; the loss of power between the dynamos and lamps would be too great if the cross section of the wires were reduced; the lamps themselves consumed more current than his idea of a perfect system approved. The latter feature of objection has been gradually removed by the increase of resistance of the filaments, so that the 16-candle lamp now requires but seven-tenths of an ampere of current, and the 10-candle lamp less than five-tenths, to give their normal light. In this idea of economy in distribution Mr. Edison is supported by the best scientists, and is still wrestling (with a good measure of success) with the disagreeable propensity of all filaments to disintegrate more rapidly as their resistance is increased.

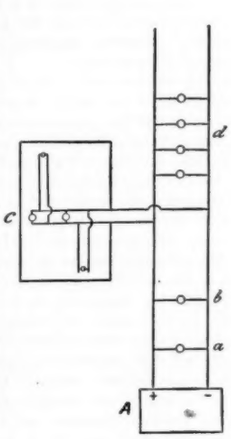


*Fig 1.*

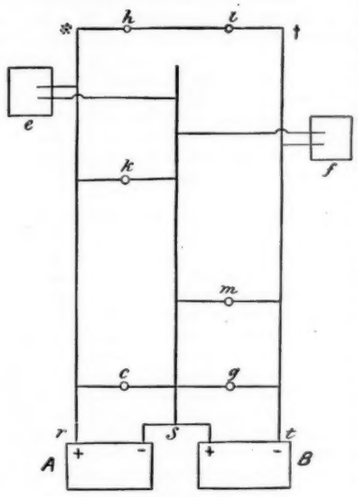


*Fig. 2.*

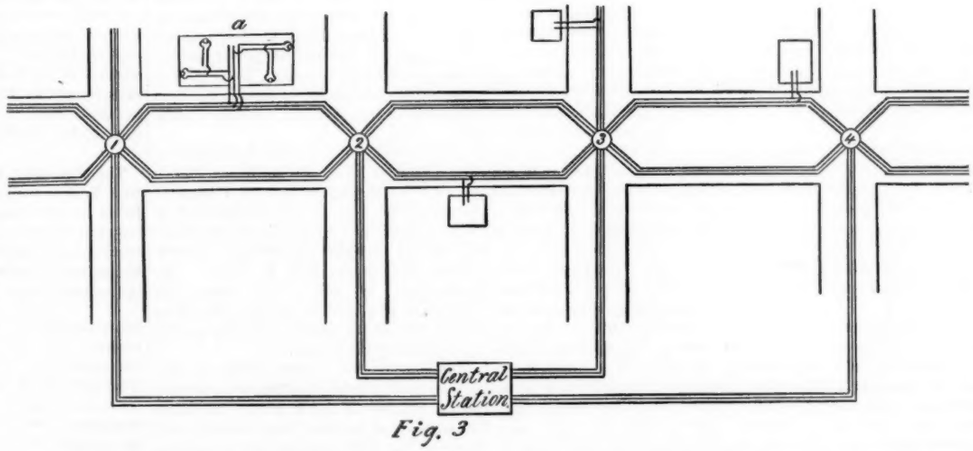


*Fig. 3*

But by far the greatest advance was made when the coupling of two machines in series utilized their combined electromotive force, and doubled the available quantity delivered over a given pair of wires at any point on the system, while the attachment of a third wire to the link connecting the two dynamos made it possible to use in any one building or apartment the force of only one generator. This peculiar arrangement, and its contrast with the old 2-wire principle, is made plain by Figs. 1 and 2. In the first we recognize the familiar idea of two parallel conductors connected with the dynamo *A*, and lamps in multiple arc on the main wires at *a* and *b*, and in any illuminated space, *c*. Here we conceive of the outgoing current, as traversing the positive main and all its connecting branches to the lamps, and returning after doing its work to the negative terminal of the dynamo. In such a system, of course, the greatest difference of potential to be considered is that existing at the brushes, and in central station work usually amounts to an E. M. F. of 115 to 130 volts, according to the loss anticipated by the calculated resistance of the conductors, and the resistance of the lamps to be used. The Edison central stations, where the loss in distribution, when the system is taxed to its ultimate capacity, is from ten to twenty per cent., are usually supplied with lamps requiring in different cases from 105 to 110 volts, and the economy of their use is thus made equal to that of isolated plants where the drop in potential from dynamo to lamps seldom exceeds five per cent., and where the lamps may be from 90 to 100 volts. It will also be readily understood by many readers that the great number of lamps likely to be attached to a central station system, and the consequent lowering of the aggregate resistance of the outside circuit with respect to the internal resistance of the dynamo, makes it very desirable that the individual lamps shall be of as high resistance as possible, that the total external resistance may be kept comparatively large.

That none may be left in doubt as to this all-important point, suppose the dynamo in Fig. 1 to be of the type known as "H," capable of carrying 450 16-candle lamps, and that each of the circles at *a*, *b*, *c* and *d* represent a group of fifty such lamps. Before connecting any lights we have, if our insulation be perfect, an infinite resistance between the conductors, and (disregarding that of the field magnets) perhaps 0.01 ohms in the dynamo. Now connecting one lamp, 150 ohms, and throwing out the resistance of the conductors, we have 0.01 : 150, or only $\frac{1}{15000}$ the resistance of the whole circuit in the machine, leaving all but a minute fraction of the energy developed by the armature to be expended as useful work in the lamp. At this stage of the experiment the resistance of the lamp circuit is at its highest point, and we secure the extreme of theoretical efficiency. Now turn on all of the 450 lights: their joint resistance is only one-third of one ohm (0.33), and so long as the coils of the armature remain cool, the ratio will stand 0.01 : 0.33, indicating that $\frac{33}{34}$ of the current is doing commercial work. Having now arrived at the normal capacity of the generator, if the number of lamps be still further increased, a second dynamo must be connected in multiple with the first, that the armatures may jointly give a sufficiently low internal resistance, and the E. M. F. be kept up at the lamps. The method of doing this will be described farther on.

Now transfer dynamo *A*, Fig. 1, to *A*, Fig. 2, and connect in series with another of the same type, *B*. Belting both to the same engine, and running a third wire from any point on the conductor *s* between the two, we have the positive terminal of the combined system at *r* and the negative at *t*, with the middle wire alike positive to *A* and negative to *B*. If the machines be run at their normal speed, the difference of potential between *r* and *t* will thus be 220 volts, and between *r* and *s* or *s* and *t* 110 volts, or the proper force for one lamp. If such a lamp, as at *c*, be connected, the *A* machine will be doing work and the current will return through *s* to its negative terminal. If, instead, *g* be turned on, only *B* will produce current. In case both *c* and *g* burn at once, the effect will be exactly as if *h* and *j* (or *k* and *m*) were in use, the double E. M. F. working through the double resistance to produce the same number of amperes as before, and the middle, or, as it is technically known, the "neutral" or "compensating" wire, practically cut. If the number of lamps on one side exceed that on the other,

a current will flow through the neutral to or from the machine carrying the heavier load, and by actuating the needle of an ampere indicator will by its direction show the side most taxed, and by the angle of its deflection serve as a measure of the difference between the two.

Now we are able to illuminate any buildings or spaces, *e* and *f*, by attaching their lamps to the *A* and *B* side of the circuit respectively; and supposing the distance of these points from the dynamos to be, for instance, one-half mile we have sent the current over that interval at an E. M. F. double that employed in Fig. 1. To secure the same carrying capacity, therefore, we need a wire of but half the cross section used before. But we are actually using but one-half the current previously consumed to do the same work, and hence our two wires need weigh but one-quarter as much as those in the first illustration. The addition of a third wire as an equalizer raises the outlay to three-eighths of the original.

To make this point more clear, notice that the joint resistance of *a* and *b*, Fig. 1, is $\frac{1}{4}^{0} = 75$ ohms. With 110 volts pressure they absorb $\frac{1}{7}\frac{1}{5}^{0} = 1.46$ amperes. Place the same lamps at *e* and *g*, Fig. 2, and their joint resistance (in series) is 300 ohms. With 220 volts E.M.F. they therefore absorb $\frac{2}{3}\frac{2}{0}\frac{0}{0} = 0.73$ amperes. And this one-half the original current, being sent from the dynamos to the lamps at twice the pressure, can be supplied through twice the resistance, or one-half the mass of copper. Consequently one-quarter the weight of wires will supply the same amount of light as before.

That this increased E. M. F. does not alter the energy expended at the dynamo is evident, for whether we consider the first case ($110 \times 1.46$) or the second ($220 \times .73$) we have the same result, 160.6 volt-amperes or watts, about one-fifth of one electrical horse-power. Thus a vast saving is effected, not only in the weight of the expensive copper conductors, but in the size of the iron tubes, the amount of insulating material needed, the weight of the boxes which join the sections, the expense of laying in the streets, and the cost of any subsequent repairs.

One of the most interesting portions of the Edison system is the method of carrying out this idea in distributing the current through the streets of a city. This may, of course, be done either by underground conductors or pole lines, though in large places the size and number of wires, and the fact that the poles should be not more than 100 feet apart, makes the inconvenience almost equivalent to a prohibition. Where an underground system is impracticable on account of scattered buildings, as in residence districts, it is often advisable to erect poles along private ways or alleys, or even between these, on the rear lines of estates, where they will prove least objectionable. If thoroughly constructed of the best material, overhead lines offer many advantages in some localities, and cost originally only about one-quarter as much as a tube system.

To illustrate the principal features of either plan, let Fig. 3 represent an underground installation in one street, with the station as near as possible to the center of consumption of light. A main is laid on each side the street about two or three feet from the curbing, and connected at convenient intervals, usually at the intersection of crossing avenues, with junction boxes, which are in practice buried near one corner of the sidewalk nearest the station, very much after the manner of a street hydrant. Each main contains three wires, and the positive, neutral, and negative of all the different mains of the system are connected each to each, as if in a single line. Feeders are now run from the station to the junction boxes, their several resistances so calculated that the greatest supply of current shall be near the point of greatest consumption. Properly constructed, the insulation of an entire system of this kind should be very high, sometimes reaching in actual practice hundreds of thousands of ohms. Service tubes may be connected at any of the joints between the 20-foot lengths, as at *a* (Fig. 3). Here the size of the building to be lighted makes it advisable to carry the 3-wire system through the edifice, dividing perhaps on each floor, or for each main department. In the cases of theatres, churches, rinks, and other public places, this plan is especially desirable, as the size of wire may be reduced, and in the event of any possible trouble with one dynamo, temporarily interrupting the light on one side, the other would continue to burn as usual. In small buildings and residences only two wires are ordinarily used. The lamps illuminating the central station are taken from the mains instead of directly from the dynamos, that their action may be noted by the operator in charge, as an indication of the working of those outside, and also because with any considerable load the drop in potential between the station and the lamps on the street, occurring in consequence of the resistance of feeders and mains, obliges the maintaining of a comparatively high E M. F. at the dynamos, which would speedily destroy lamps of the resistance—or, as technically known, of the "volt"—used by consumers.

Right here we encounter one of the cardinal difficulties of distribution for incandescent work—that of equalizing through the system the drop in potential occurring whenever its capacity is approached. To secure theoretically perfect results, the resistance of all the feeders and mains must be so proportioned and regulated that however the resistance of any point or section of the lamp circuit may vary, the current shall maintain a uniform pressure in all the ramifications of mains and inside wiring of buildings, and each lamp give the same light as every other.

Practically this is impossible, but we may far exceed the best regulation of a water or gas pressure in our approach to the ideal conditions. It is only necessary in addition to a proper calculation of the resistance of each of the several feeders, in their construction, to slightly vary their conductivity from time to time by means of resistance boxes known as "equalizers," introduced into their circuits at the station. Now if in consequence of a large consumption of light in the neighborhood of *a*, (Fig. 3) the pressure drops at boxes 1 and 2, a little resistance on feeders 3 and 4 will divert sufficient current through the weakened channels to restore the equilibrium. That this variation of potential at the ends of the feeders may be known and regulated, each feeder tube is supplied with three small wires connected with the system at the junction box which forms the feeder terminus, and acting as a return circuit to the station, where a volt meter or indicator of peculiar construction is attached on each side. This arrangement appears in Fig. 4. If for any reason the equalizers are not used, the average of the readings of the various indicators on the *A* and *B* sides respectively, determines the E.M.F. to be secured by the dynamo regulator in each case. By these methods and devices, in connection with mains and house wiring so calculated as to avoid the heating of small wires by attaching too many lamps, and raising the candle-power in other localities by reason of excessive conducting capacity, the regulation is effected with so much nicety that there is no perceptible difference in the brilliancy of lamps throughout the system.

Perhaps there is no one point more forcibly illustrated of the adaptability of the Edison methods to the constantly varying requirements of central station work than the readiness with which the dynamos may be connected to work together, like spans of draught animals, each adding its measure of efficiency to the power of the others to produce a common result. At the Louisville exposition last year, sixteen 450-light machines were so arranged as to be connected like horses working tandem, and in the New York station the six mammoth dynamos, capable of carrying 1300 lights each, are manipulated in precisely similar manner, the only care needed being to keep their E.M.F. equal that the load may be well divided, and that no tendency may develop in those giving normal current, to short-circuit by overbalancing the reduced force of any other, and pouring their current through its armature. In practice this is perfectly easy. The exact conditions in the case of the three-wire arrangement may be understood by Fig. 4, which also shows the method of connecting the generators with the regulating mechanism and the feeder system.

Here are two dynamos of the "S" type, (200 lamps each) bolted preferably directly to the two driving wheels of a 50-horse Armington & Sims engine, so as to secure from 1400 to 1500 revolutions of the armature. This pair of machines will carry from 600 to 700 10-candle lamps, and is very valuable in a small station, inasmuch as the early evening and late night work may be done with much greater steam economy than by the heavier "H" machines, which are actuated, in the case of all the stations now in operation, by $14\frac{1}{2}$x13 inch engines, of 125 horse-power nominal. The field regulator connections will be perfectly understood from the sketch. Each machine is directly attached to a "double dynamo switch" having an arm consisting of two insulated broad contact blades, pivoted midway of its length, and readily movable by a non-conducting handle at its lower extremity. The normal position of the switches of four machines, for the ordinary work of the station, is shown in the figure. Any dynamo in the station may thus be so connected, at a moment's notice, as to take the place of any other, as in practice a spare engine is always kept "warmed up," its piston barely moving, ready to speed without delay.

The process of switching so as to avoid flickering and flashing of the lamps on the circuit is a very interesting one to every visitor. The ruling spirit of the station is at the regulators, his assistant at the double switches. If the load is on the increase, and to be thrown from the "S" to the "H" machines, the latter are brought to speed, and as he turns out the resistance from their field circuits, the electrician watches the dynamo lamps until those on the heavy pair arrive at the proper comparative brilliancy. A nod to the assistant, and the handles of switches 3 and 4, which have hung perpendicular, are thrown to left and right respectively, and both pairs of generators are working in unison. Carefully turning out resistance in the fields of the incoming dynamos, and at the same time weakening those to be relieved, the load quickly shifts, and at another signal switches 1 and 2 are pulled down, the full resistance is thrown into the field coils of their dynamos, their magnets almost instantly lose all their power, and the engine is stopped at leisure. Not a flash or perceptible variation in the lamps, hardly a vibration of the delicate pressure indicators.

The neutral wire is usually designated by the character ∓. From it a branch is taken to the upper side of a bank of lamps, (from one to several hundred in number according to the size of dynamos) by the aid of which the efficiency of any engine or generator may be tested. The connections by which these lamps, (in sections of fifty) may be instantly placed on either side of the circuit, will be readily understood by the outline.

Just outside the ampere meters on the positive and neutral omnibus wires are two heavy switches (*X* and *Y*, Fig. 4) by which the positive or negative may be cut at will. Suppose that while carrying only a medium number of lamps, dynamo 3 suddenly gives out. Throwing the lever of switch *Y* downward, the circuit of the useless machine is instantly opened, and with barely a flicker the load is saddled upon its companion, which now supplies both sides of the circuit, the neutral wire becoming positive to both the others. In such a case, which is very unusual but possible, the E. M. F. is reduced to 110 volts, and the number of lamps which can be kept at candle power depends upon the carrying capacity of the middle wire of the system, which must supply all the current used. Under these conditions, it is interesting to notice, two lamps connected in series, as at *h* and *j*, Fig. 2, would go out, the outside wires being of the same polarity.

The "omnibus" wires here divide, and the positive and negative pass through the equalizers (which are represented in the figure greatly reduced in proportion), and also heavy plug switches and the station safety catches (carrying from one hundred to several hundred amperes before melting), and by flexible cables join the feeder conductors. The small pressure wires issuing from the tubes are connected with those above the omnibus wires and lead to the indicators.

The presence of a ground on the system is instantly shown by a group of four lamps permanently connected to earth and to the middle wire, and so adjusted by a plug switch as to be readily attached to either positive or negative in the manner indicated in the figure. The phases of their operation are very difficult to describe, but will be understood by any electrician. They give something like twenty-five different indications and are very valuable as a tell-tale, showing any variations in the practical insulation of the system.

The three-wire plan, as thus far elaborated, illustrates very forcibly the advantage of a system connected as a single network of conductors, over that of radiating lines. If a main be broken at any point so that the supply of current from the nearest feeder is cut off, it is still charged from the other direction. As Mr. Edison has graphically expressed it, "the current comes around the corner from the next block, and the lights still burn." If a feeder be from any cause disabled, the plugs are removed from the switches on its wires at the station, the safety catches by which it is connected with the system at the catch-box on the street, are taken out, and it can be readily repaired while the remaining feeders supply the mains.

As a motive power for Edison central stations, the Armington & Sims engine has deservedly taken high rank. Without being supersensitive in its governing facilities, it responds instantly to every heavy call upon its energies, and in the event of an accidental short-circuit, when the strength of the magnets and their pull upon the armatures may be quadrupled with the rapidity of thought, its regularity of action is phenomenal. It is the only machine yet tried by the Edison Company which has shown entire fitness for actuating numbers of dynamos in parallel arc and the satisfaction which it has given under the severe tests, at 350 revolutions per minute, sometimes for days together, imposed in the New York station, is sufficiently attested by the fact that it has displaced the majority of the Porter-Allen machines first installed there, and is being exclusively used in the addition now nearing completion.

The three-wire plan is to be utilized in New York in the new up-town district projected by the company. Outside this first center it is now in successful operation in fourteen cities and towns in the Eastern and Middle States, their capacity being shown by the annexed table:

| | Lamps. |
|---|---|
| Brockton, Mass. | 3,200 |
| Lawrence, " | 3,200 |
| Fall River, " | 1,600 |
| Newburgh, N. Y., | 1,600 |
| Sunbury, Pa., | 500 |
| Shamokin, " | 1,600 |
| Mt. Carmel, " | 500 |
| Bellefonte, " | 800 |
| Hazleton, " | 1,000 |
| Williamsport, " | 3,200 |
| Middletown, Ohio, | 500 |
| Piqua, " | 500 |
| Tiffin, " | 1,000 |
| Circleville, " | 1,000 |

Of these the first four are underground, and were installed in the order mentioned. At Brockton, where Mr. Edison personally superintended the opening of the work, Oct. 1 1883, the rapid increase of patronage necessitated doubling the engine and dynamo capacity last spring. Here the majority of consumers preferred much concealed wiring and elaborate fixture, and proved their willingness to submit to the extra expense thus incurred. As a consequence the New England Wiring Company, which was organized to take charge of this branch of the busi-

ness, show in Brockton some of the finest workmanship and most pleasing effects which are to be seen in the Edison field.

It would be a matter of much interest to many readers to describe in detail the various devices in indicators, regulators, switches, meters, safety appliances, tubes and their connections, which combine to make it fitting that we characterize the Edison methods as a well-elaborated system. Visitors to the electrical exhibition at Philadelphia next month will have abundant opportunity to examine at their leisure these outgrowths of recent progress, as well as to gain by their own observation of the machine in actual service a more specific knowledge of what we have endeavored in the foregoing columns simply to outline.

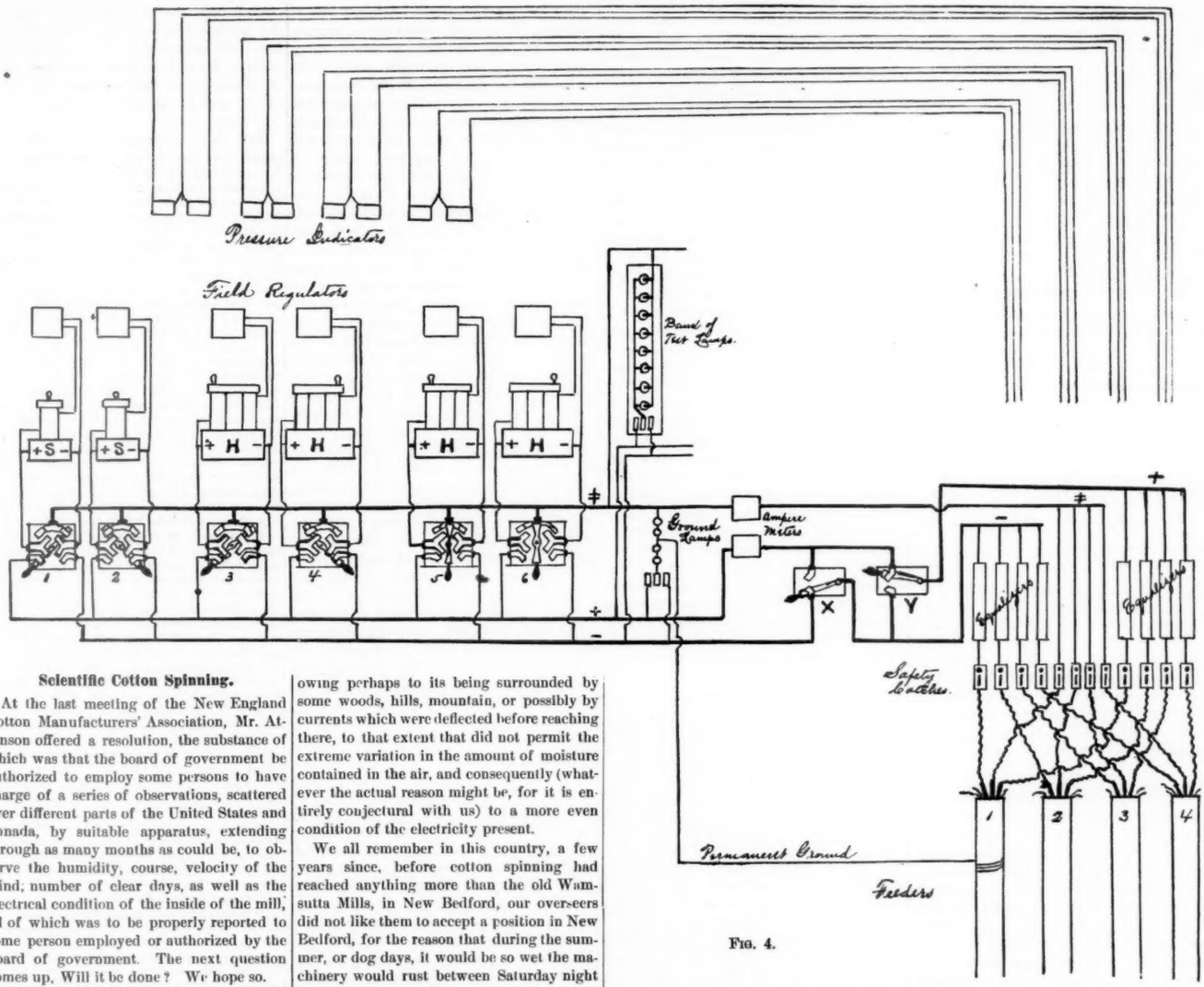


FIG. 4.

## Scientific Cotton Spinning.

At the last meeting of the New England Cotton Manufacturers' Association, Mr. Atkinson offered a resolution, the substance of which was that the board of government be authorized to employ some persons to have charge of a series of observations, scattered over different parts of the United States and Canada, by suitable apparatus, extending through as many months as could be, to observe the humidity, course, velocity of the wind; number of clear days, as well as the electrical condition of the inside of the mill, all of which was to be properly reported to some person employed or authorized by the board of government. The next question comes up, Will it be done? We hope so.

Scientific cotton spinning has been sneered at by a great majority of the cotton spinners in this country as well as by some who know nothing of spinning cotton, but who are professors by assumption. Both classes we can afford to taboo for the time being. There are still some intelligent men engaged in cotton spinning who are always looking out for anything that affects their business, their interest, their production, and, more than all the rest, if for no other reason, anything that affects the profit of their operation. If now we can ascertain, by systematic observation, which is the only proper way, what the course of these currents is, when electricity hinders us most, find out all the conditions attendant at the time when it is least present, ascertain all the conditions that are possible to ascertain, and then, whenever any extreme range of variation takes place, by observing different parts of the country, we can tell something about what does occur in St. John, Montreal, Graniteville, Augusta, Cohoes, Fall River, or New Bedford.

It is a well-known fact that cotton spinning in England is now gravitating very largely to the immediate neighborhood of Bolton, for finer numbers, and to Oldham the increase is immense. Mills which have been situated in an isolated position, with regard to other mills, do not seem to grow. But to a very great extent the increase in spindles about Oldham has been prodigious, and, for the fine spinning, around Bolton and in that immediate vicinity for a small circle. Now, there must be some reason for all this; and, if the same thing were done in England, there is no reason at all why we should not find out all the facts connected with it ultimately; and we should not hazard much if we were to say that among the array of facts shown, undoubtedly there would be included the fact of more average hygromatic conditions, owing perhaps to its being surrounded by some woods, hills, mountain, or possibly by currents which were deflected before reaching there, to that extent that did not permit the extreme variation in the amount of moisture contained in the air, and consequently (whatever the actual reason might be, for it is entirely conjectural with us) to a more even condition of the electricity present.

We all remember in this country, a few years since, before cotton spinning had reached anything more than the old Wamsutta Mills, in New Bedford, our overseers did not like them to accept a position in New Bedford, for the reason that during the summer, or dog days, it would be so wet the machinery would rust between Saturday night and Monday morning, or the belts would open on the laps, or something else. This was theoretical and was prejudicial. The same thing, to a certain extent, was said of Fall River years ago, and yet we hear nothing of it to-day, so far as the spinning of cotton goes. Fall River is eminently successful in production, in quality of goods, in everything except the rowdy element, and for that the manufacturers are not particularly responsible.

But in New Bedford, we have seen within the last few years, since the active men have been put at the head of the spinning, a tremendous growth. And in the case of the Acushnet Mill, it is built almost in the water, so is the Grinnell, while the Wamsutta is but little better; and yet we have not heard that they bought flour of emery and grease by the ton for scouring off rust, and we do not find, so far as we have been allowed to know, that the production of these mills, as a matter of fact (as well as the old Naumkeag at Salem, which stands on the wharf, or the Peabody at Newburyport), stands relatively higher per spindle, or per loom, during the worst days of March and the dog days in August, than mills which are situated 200, 300, or 500 feet above the level of the sea. Is there not then something in the fact that static or dynamic electricity has a particular choice as to where they are, and when they are there? There are a great many questions which will enter into this investigation if properly pursued. The condition of the cotton at the time would be most interesting. This could only be observed on the spot, and would require a large corps of observers; but the strength and elasticity of the yarn, if carefully observed and recorded—when compared with the amount of moisture in the air, the amount of electricity present, and the general condition of mattters—would all together make valuable information for spinners, and while it will not be necessary to move all the mills to the sea coast, we may find how to avoid the difficulties which we now have to encounter.

We shall also have a train of observation extending, we hope, from Atlanta, Ga., to St. John, N. B., and from that point to Montreal, or as far West or Southwest as it is possible to obtain them. But this will only be the beginning of a most important examination, and what the end will be we are entirely unable to say; it will simply be an investigation into something which has never yet been done, and if our manufacturers will support the carrying out, we believe that as soon as they see what is possible from these recorded results, it will then go a vast deal further. This will only be the commencement of an investigation that is bound to do something to disabuse our spinners of old-time preferences and prejudices, and is one of the investigations that will certainly bring out information that is very valuable.—*Manufacturers' Gazette.*

## Earth Currents.

The *Journal Telegraphique* gives a translation of an article from No. 5 of the *Maanblad voor Telegraphie* for 1884, by Mr. Hissink, of the Dutch Indian Telegraph Service, from which we take the following:

"We observed very strong earth currents on the 17th, 20th, and 21st April, 1882, traversing the line which unites Lahat (Island of Sumatra) and Benkoelen by way of Tebing Tinggi. The length of this line is 220.73 kilom., and its resistance 970 ohms. On the 17th April the earth current appeared directly the daily work was begun, at 8:55 A. M., and from time to time telegraphic communication was interrupted up to 4 P.M. The currents were particularly strong from noon to one o'clock. The needle of the Siemens sine galvanometer included in the circuit to Lahat gave all kinds of deflections, now −65°, now +45°. The current varied at long intervals, and each time changed direction. The two other lines going from Lahat to Moearadoea and Palembang, which ran in a different direction, were only traversed by weak earth currents. On the 20th April we again observed more or less strong earth currents traversing the same line between Lahat and Benkoelen. The galvanometer indicated from 9 A. M. to 9:15 A. M. a deflection of +15 to +25; at 11:25 this became −37; at 11:50, +27; at 12:8 noon, +15; at 12:10, −5; at 12:14, +3. Later on the current varied every moment; the greatest deflection, that of −49, was observed between 2:30 and 3 o'clock. The current then flowed without interruption in a direction from Benkoelen to Lahat. Communication with Tebing Tinggi office was occasionally interrupted. On the morrow we made similar observations up to 3 o'clock. Later on we found that the wire between Benkoelen and Tebing Tinggi had been broken at eight leagues from Benkoelen; but the deflections of the needle and the other observations made enabled us to ascertain that the line was affected by earth currents."

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*We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.*

*We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.*

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It is a lucky thing for a good many people that the psycho-electric machine for thought recording, described on another page, is a hoax, and not a reality. It would be a very uncomfortable thing to have around.

Josh Billings once said that he never knew a mule to have any disease that a good club wouldn't cure. In the same way it may be said that in nine times out of ten, when telephone managers lay back and growl about "induction" and "retardation" on their lines, and spin fine theories, a good lineman, with a soldering-pot to make joints perfect, and a pair of clippers to cut twigs, will remove all the "trouble" and give a clear line. Induction is plenty enough, in all conscience, but many a sin is laid at its door of which it is innocent.

If abundant, well-arranged, well-edited and handsomely printed "literature" will make all facts concerning the approaching World's Exposition in New Orleans known to the public, certainly there can be no excuse for ignorance concerning them. Our table is daily deluged with maps, plans, rules and regulations, circulars of information and other printed matter, in which everything is so plainly put that he who runs may read. There must be somebody down that way who has studied the excellent methods devised by the managers of the annual Cincinnati Exhibition, and has profited by the study.

On Friday evening of last week the Thomson-Houston company gave an exhibition at their factory, in Lynn, Mass., of the apparatus which they will show at the Electrical Exhibition in Philadelphia next month. At their request we abstain for the present from any detailed description, but limit ourselves to the remark that if the other electrical companies take anything like the pains shown by the Thomson-Houston company to present a complete exhibit, the show in Philadelphia will be by far the most interesting, instructive, and valuable ever seen in this country. Those who think that the work of the Thomson-Houston company has been confined to the manufacture of the well-known arc lamp, which bears their name, will meet with several very agreeable surprises.

The use of small electro-motors for domestic and small manufacturing purposes has long been talked of, and its advantages have been dwelt upon and enlarged upon, but, until very recently, it has not seemed probable that it would be a practical success. But it now looks as though something would come out of it. Experiments in Boston have developed the fact that a small motor can be attached to an ordinary sewing machine, and run on and in connection with an ordinary arc light circuit, that, by more or less pressure on the treadle, the speed can be regulated at will, and that two of these motors will not consume as much power as an arc lamp. Thus a twenty-five light dynamo would furnish power for two hundred and fifty sewing machines; and, as not over one-half of these would be likely to be in use at the same time, it would be safe to connect up at least three hundred and fifty machines, giving to each person, in consideration of so much per diem or per week, to use it at will. In this connection, it is interesting to note one unlooked-for effect of the introduction of this system into a workshop where a large number of machines, hitherto driven by steam, are used. Under the *regime* of steam, the girl operating a machine could not regulate the speed. She could throw the belt off or on, but when a modification of velocity was required she had to stop and call upon the foreman to make the adjustment. With the electro-motor and its accompanying regulator, she can vary the speed at any instant simply by greater or less foot pressure, and this fact has resulted, in actual use, in her accomplishing a far greater amount of work in a given time. Experience thus far seems to indicate that, considering its advantages, electricity can compete favorably with steam in driving sewing machines and other light machinery.

Low rates are ruling for telegraph messages just now, although the Western Union declines to meet the cut, except through its running mate, the Mutual Union. By the united lines the almost universal rate is 25 cents for ten words, and one cent for each word additional. For night rates the standard is 15 cents for 15 words. Statistics show that day messages average 14 words each. Hence, in reducing the price for additional words from two cents to one cent each, the united lines make a cut of an average of four cents on each message, without taking into account the reduction for the first ten words. Primarily the public is going to get the benefit of this reduction, because it is going to get more for its money, but in the end the telegraph interest will be the greatest gainer, because the public is sure to be led into using the wire far more often and far more freely than ever before. When a business man, by increasing the length of his message, can make it explicit and precise at the expense of only one cent per word above the original ten, he is not going to cut and carve to come within the prescribed limit, and the result will be that not only will messages multiply in numbers, but increase greatly in average length. One word of suggestion as to the management of the united lines and of the Mutual Union. Neither one nor the other has taken pains to let the public know how cheaply they are doing business. Of course it has been mentioned in the daily papers, but there have been so many changes that the public does not keep posted. We are not bidding for an "ad," but we have a theory on this subject of cheap telegraphy which we believe the event will prove to be correct. But unless the public learns the facts, and that speedily, there will be no fair test. *Suggestion:*—Print your rates on your message blanks, in place of that long contract that nobody reads or cares for.

## *THE FUTURE OF ELECTRICAL INTERESTS.*

Said a gentleman who has sought to become connected with electrical interests, but has been deterred by the uncertainties that environ the stability of the patents involved, "We have had such a shower of patents during the past five years, such a multiplicity of claims, counter-claims and interferences, such a jumble of litigation, agreements, compromises and consolidations, that no man can tell exactly where he does stand, or whether what he thinks belongs to him is his own. The shower will be over soon; a year or two will clear away the clouds; many fundamental patents will expire, and *then* will be the time to take hold. In the meantime, I intend to sit quietly on the fence and watch the procession." All very well; but, if you perch there until the end of the procession is in sight, you will "keep your sitting," to use a homely phrase, until the top rail is pretty well worn through. There *has* been a pretty lively shower of the kind described, it is true; but, after all, it is only the precursor of a long and steady rain, the end of which no man can see. It is true that what seem to be fundamental patents are going to expire within a few years, but it is also true that the apparatus and appliances based upon them will seem antiquated and obsolete long before they actually become public property, and that a perennial crop of new patents and claims, based on new discoveries and the improvements growing out of them, will take the field and keep the procession moving. Every electrical company is fortifying itself against the future in this way, not wholly as a matter of policy, but because its experts are continually crowding new discoveries upon it, and urging it to patent them. The man who imagines that present owners of business based on patents are going to abandon it when their basic patents expire, and surrender the advantage which long occupancy of the field gives them, will find themselves grievously mistaken. Indeed, it will be a pretty slim concern that will not show, year by year, two new and valuable patents for every one that expires, and that will not, with these, and with the advantage which time and experience afford, hold the field successfully for many years.

Nor is it upon employed experts alone that the several companies depend for new strength and life. All over the country bright minds are at work upon the solution of electrical problems, and, when successful, their work finds a ready market among companies already established. The invention of some improvement or simplification in apparatus, rendering it more efficient or more economical in operation, is valuable in proportion as it is useful to those using such apparatus, and it is among them that a market is found. This demand insures a prompt reward to the inventor, and the fact that there is competition to secure whatever is valuable makes it adequate. Thus the tendency is to concentrate the ownership of electrical inventions in the several branches, and to keep new companies out of the field.

To return to the remark quoted at the outset, it is safe to say that the man who waits until invention stops, and all electrical enterprises now known are free to the public to engage in, will wait longer than any man now alive is likely to live, and that the time to "go in," if at all, is now, for the longer he waits the further he will be from the head of the procession. As for its tail, he will never see it. He will never know a time when there will be less complication, uncertainty and litigation than now, and the chances are that, as time progresses, all these will increase and multiply beyond any one's present expectation. The road is far from smooth to-day, but it is destined to be far rougher, and those who are bent on following it should "fall in" now.

## *THE RIGHTS OF TELEGRAPH COMPANIES.*

It seems somewhat singular that in their efforts to secure and maintain rights of way in cities the telegraph companies do not bring more prominently forward the rights accorded them by United States Statutes. The revised statutes give to the telegraph companies, in terms plain and unmistakable, the right to erect their poles and run their wires over all post roads in the United States, and in another section they specifically declare that all roads and streets over which the mail is carried, and all letter carrier routes are post roads. Clearly, then, the streets of New York and Brooklyn, and of all other large cities, are post roads, and the rights granted to telegraph companies certainly apply to them. It is true that the right to determine exact locations belongs to the municipal authorities in each city, but, unless the statutes of the United States go for nothing, the right to plant poles and string wires comes from the Congress of the United States, and no authority less than this can take it away.

This right is granted to telegraph companies, and none others are mentioned, but it may reasonably be claimed that telephone companies, even when the word telegraph does not occur in these tables, are in fact telegraph companies within the meaning of the statute, and that, as such they are entitled to the privileges which the statutes grant. In view of the recent decision of Judge Ingraham in this city to the effect that a pole in the street is an obstruction, and that neither the city, holding the streets in trust for the people, nor the State has any authority to grant to any one to erect poles or string wires, it behooves all electrical companies to look into their rights, and maintain them *aggressively*. Thus far poles and wires have been kept up by a series of subterfuges, aided not a little by the good-nature of the public. But this cannot last always, nor is it wise for great companies, whose interests run into the millions, and whose services are indispensable to the welfare of the whole community, to allow their business to rest in so large a degree upon a foundation which is insecure and uncertain, and vulnerable at all points.

Incidentally in this connection, it may be suggested that it is high time for wire companies other than those already mentioned to take some concerted action, first to ascertain and secondly to maintain their rights, if they have any. In all of our large cities there are hundreds of miles of electric light wires. They have cost vast sums of money, and the work of putting them up and erecting the supporting poles and structures has been very expensive. There has been a howl against them, created, it is true, very largely by interested parties, but it nevertheless exists, and is finding voice every day in the public press. Moreover, it is growing, and the public has become embued to a very great extent with the idea that overhead poles and wires are in many ways dangerous, and menace not only the safety of the individual but of the community as well. It is useless to argue that their fear is ill founded. It is unreasonable, it is true, *but it exists*. It has been carefully fostered and encouraged, and it is to-day an element of evil which threatens the interests of every wire-using company of every description.

"What are you going to do about it?" is the natural question. The answer is "combine." Those whose interests are identical should act together, forming an alliance offensive and defensive, taking the ground that an attack upon any one company which tends to disturb its poles or wires is an attack upon all, and as such is to be met with all the resistance that all combined can bring to bear.

It is beyond question that those who, from interested motives, have used their endeavors to destroy the present overhead system of wiring, notably those who are interested in one or the other of the hundred and one underground systems now before the public, have not scrupled to seek to influence legislation in these interests, and, aided by the ignorant discussion of the subject in the public press, they have, in this State particularly, in part succeeded. The devil is to be fought with fire, and there is no reason why the wire-using companies, in order to protect their own interests, and those of their stockholders should not have recourse to the same methods, and at least try to keep legislation in channels not unfriendly. As for presenting the scientific side of the question to legislators, it is time and effort thrown away. The practical side is what they can understand and are interested in, and if it be made clear to them that legislation such as they have entered upon will wreck vast interests, and rob the public of facilities upon which they have learned to depend in the course of their daily business, they will pause before consummating it.

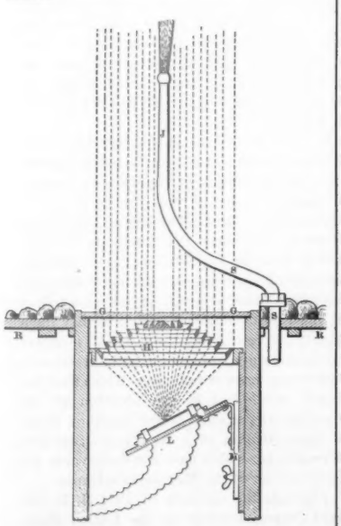
## Electric Lighting at the International Health Exhibition.

THE ILLUMINATION OF THE FOUNTAINS AND WATER WORKS IN THE GROUNDS.

One of the most popular of the many attractions at the Health Exhibition, and that which more than anything else renders the Wednesday and Saturday evenings, as well as special holidays, so remunerative, is the brilliant exhibition of the illuminated fountains and system of water works which have been designed upon a very novel and extensive scale by Sir Francis Bolton, R. E., the object, which has been so successfully attained, being to produce as many different combinations as possible of form, color, total reflection, and general effect of composition.

The arrangements are as follows: In the middle of the ornamental water there has been constructed an island, which is in reality a chamber underneath the principal group of fountain jets. In this there are placed the regulating valves by which the various systems of fountains are controlled, the optical and electric light apparatus by which some of the more brilliant effects are produced, and the electric signaling apparatus by which the assistants receive their orders from the "commanding officer," whose position is in the tower just below the clock face. Upon the island, and therefore above the hidden roof of the chamber, are fixed nine fountain jets, that is to say, a high central jet projecting a column of water from an orifice of 1¼ inch in diameter to a height of 120 feet, four jets, each having a 1-inch orifice, disposed at the four corners of a square, of which the high jet is in the center. Around each of these corner jets is fixed a horizontal ring 2 feet 6 inches in diameter, constructed of 2-inch pipe, and carrying twelve ¼-inch jets, and between these corner jets are four "dome and convolvulus" jets, the water issuing from them taking the form of a dome surmounted by a lily or convolvulus. Around the edge of the island is a set of small jets, which form a sort of water fringe, and a somewhat similar set of little jets is fixed around the edge of the main basin.

In this basin there are three distinct systems of fountains, which we may refer to as the outer, the middle, and the inner rings; they carry various kinds of jets, some revolving after the manner of a Barker's mill and scattering water with a sort of spiral motion, others fixed and of different shapes, while many are fitted with finely perforated roses by which very beautiful effects of mist can be produced. There is also a curtain of water spray about 39 feet long, which is thrown up immediately in front of the cascades to such a height as will admit of effects being produced upon the curtain by the dissolving view apparatus, which is in the island.



The water for the whole system of fountains, after passing the special meters, is delivered by a 9-inch main at a pressure, varying throughout the day, of about 65 pounds per square inch, or a head of 150 feet; this supply is connected direct to the West Middlesex Water Company's pumping main at Hammersmith. The 9-inch main is carried along the bottom of the basin into the chamber in the island, and there forms a square loop, of the same cross section, and from which the services leading to the different systems of fountains take their supply. Each of these service pipes is fitted with a regulating valve by which its respective series of fountains can be turned up and down, either gradually or suddenly, for some of the most interesting effects are produced by raising one jet while another is lowered, or by causing a single jet, or a group of jets, to pulsate. In order to facilitate the prompt execution of the orders signaled from the clock tower, the various mains within the chamber and their respective valves are painted different colors; thus, the pipe which supplies the outer set of fountains is painted blue, that for the middle ring red, for the inner ring white, black for the little rings encircling the corner jets on the island, and yellow for the fringe around the edge. It is therefore only necessary to signal a color in order to indicate to the assistants the particular sets of fountains to be operated. We shall, however, refer again to this when describing the signaling apparatus.

Besides the various fountains above referred to, there is, below the Albert statue, the cascade, which has, from the first, formed part of the permanent decorations of the Royal Horticultural Gardens, and two temporary water towers, from the top of which three illuminated streams of water pour into the lake. In addition to these there are the four canals, in which the only feature of interest is the illuminated device and cascade at the inner end of each basin, four Soleil lamps being used for this purpose.

The simple yet elaborately worked-out system by which these water works are illuminated at night, and by which the various very charming effects are produced, is one of the most interesting features at the Health Exhibition. In this installation alone there are no less than twenty-one arc lights, and we understand that some 200 incandescent lamps will shortly be added.

The illumination of the fountains in the central basin is effected partly by throwing upon them from the clock-tower concentrated beams of electric light, both white and colored, and partly by projecting from below them, by means of suitable optical apparatus, vertical columns of light which, by strongly illuminating the water as it issues from the jets, and being reflected by the countless drops of water as it breaks up in mid-air, fills the atmosphere in and around the jets with tens of thousands of sparkling gems of light and color, thereby producing beautiful and very remarkable effects.

Pleasing effects are also obtained by throwing upon the cascades bands of differently colored light, or by employing the water curtain as a screen to receive images projected by a magic lantern, while another series of effects are brought about by illuminating the central group of jets with concentrated light and surrounding them with mist illuminated by diffused light.

The arrangements by which the central fountains are illuminated from below will be understood by referring to the accompanying figure, which is rather an illustrative diagram of the method of illuminating the central fountain than a sketch of the actual apparatus employed. Immediately below the nozzle *J* of the central jet is fixed a circular plate of glass *G G*, which forms a water-tight window in the roof *R R* of the chamber under the island, and below this, and co-axial with the jet, is fixed a sixth order catadioptric holophote *H* about 23 inches in diameter, built up of six reflecting zones and a central Fresnel lens constructed of a middle lens surrounded by two refracting rings. The focal length of this holophote is 150 millimeters, and it condenses all the upper rays emanating from a source of light at its focus (which lies in the plane of its outer zone), into a vertical cylindrical beam of the same diameter as the outer reflecting belt. Near the focus of this holophote is placed a simple arc lamp *L*, carrying a pair of carbon rods which are regulated by hand by a simple rack and pinion adjustment; the lower pencil is one of Siemens 18 millimeter cored carbons having a hard shell and soft core, and the upper pencil is hard carbon 16 millimeters in diameter. In this case the lower and cored carbon is the negative in order to get the light-giving crater at the bottom. The lamp is, for this reason, set at an angle with the horizon (but not so great as that shown in the diagram), and is attached by a bracket to a sliding block of wood, while its focal adjustments can be made. The four corner jets are illuminated in a precisely similar way, except that in the place of a holophote, a horizontal Fresnel lens of 20 inches in diameter is employed, the lamp and other arrangements being exactly the same as for the central fountain.

In each of the two water towers, and fitted with suitable optical apparatus, are three Siemens focus-keeping lamps, each placed in such a position as to throw a concentrated beam of light through the axis of a horizontal glass tube which projects over the ornamental basin and through which a stream of water will be allowed to pass; the effect of this will be that six luminous streams of water will flow from the top of the towers into the lake below. All the lamps, both in the island and in the towers (that is to say, eleven lamps), are worked in parallel circuit from a new form of Siemens direct current machine, to which we shall refer later on, and the resistances of the lamp circuits are so balanced by means of wire and ribbon resistances (fixed in a small hut in the grounds) that the six Siemens lamps, each taking 20 amperes of current, and the five hand lamps, each taking 60 amperes, receive neither more nor less than their proper working current.

The electric light apparatus within the clock tower consists (1) of a hand-adjustment lamp fixed in a military holophotal projector, which is capable of being directed in different directions both in altitude and azimuth, and deriving its current from a Crompton-Burgin machine; this apparatus is fixed just above the clock face, and projects its beam through a window on to the fountains. (2) A second military projector fixed above the clock room and at the foot of Edmund's mast light. In this is a Siemens focus-keeping lamp, deriving its current from a Siemens alternate current machine. (3) Two Brush focus-keeping lamps, one on each side of the clock-face, and each in the focus of a silvered parabolic reflector which can be directed to different angles of altitude and azimuth. All these lamps, as well as those on the island and in the towers, are fitted with suitable switches, by which they may be thrown in or out of the circuit at any moment. Various colors and combinations of colors are given to the beams by sheets of colored glass or gelatine plates interposed in the beam in front of lenses, and the rapidly changing effects of color are produced by a set of differently colored gelatine plates drawn in succession through the path of the beam.

The electric signaling apparatus consists of a key-board of thirty-six pushes fixed in the clock-room from whence the orders are given, and these are connected by wires with the indicating apparatus in the island and on the water towers. This latter apparatus consists of two electric bell indicators, one for giving instructions respecting the valves, and the other for controlling the lights. The eight tablets in the "water indicator" are labeled respectively "Steady," "Red," "Green," "Blue," "White," "Black," "Center," and "Yellow," and refer to the valves which regulate the different systems of fountains, and which, as we have described, are painted with the above colors in order to readily distinguish them and to facilitate the signaling. The "light indicator" has six tablets, labeled respectively, "Center Lamp," "4 Side Lamps," "Blue," "Yellow," "Red," and "Green." There are besides several electric bells, one large bell, labeled "On," and a smaller bell "Off," indicating that the water or the lights are to be turned on or off, the signals on the indicators showing to which it refers; and, in addition to these, there are bells of different tones for calling attention or for answering an order. The pushes on the key-board correspond, of course, with the tablets on the indicators, but an almost infinite number of orders can be conveyed by combining two or more signals together, and Sir Francis Bolton employs this means to indicate to the assistants, in charge of the valves and lights, any one of the multitudinous effects which he may at any moment desire to produce.

The hand lamps and Siemens focus-keeping lamps are, as we have already pointed out, worked in parallel circuit by a Siemens direct current machine which is fixed among the other electric lighting machines of the Exhibition. This machine is of a very novel and interesting type, and we hope on an early occasion to illustrate and describe it. The special feature of novelty lies in the fact that the armature is not coiled with wire as the Siemens machines usually are, but, more like some of the Edison machines, is built up of thick longitudinal bars or prisms of copper connected at the ends of the armature in the manner peculiar to the Siemens machine. This armature rotates at a speed of 773 revolutions per minute within a magnetic field, the coils of which are partly in shunt and partly in direct circuit with the external circuit of the apparatus, which is thus in itself to a great extent self-regulating. It gives a current of 420 amperes, with an electromotive force of 80 volts—equal to 33,600 watts. The contact of the commutator brushes is maintained against the commutator by means of springs adjusted by a screw, and their position with respect to the magnetic field is regulated by a well-designed worm and worm-wheel adjustment fitted with locking gear to hold the brush holders in their most efficient position. The current for the machine is conveyed to and from the hut in the grounds by four well-insulated cables, each made up of nineteen strands of No. 12 B. W. G. copper wire, and from thence is distributed to the island and towers, the respective currents to each branch being balanced by resistances placed within the hut.

The only feature of interest in the side basins consists in a set of spiral glass tubes, placed close together vertically side by side, and rotated alternately in opposite directions by means of an undershot water-wheel driven by a cascade which falls over them. Above this mechanical device, which has been constructed by Messrs. J. Defries & Sons, is fixed a Soliel electric lamp behind a sheet of ruby or other colored glass.—*Engineering.*

## Electric Resistance of Glass.

Messrs. T. Gray, A. Gray, and J. J. Dobbie, of Glasgow University, have been investigating the electrical resistance of various kinds of flint glass, as made by different makers, with a view to find out the relations existing between the resistance and the chemical constitution of the glass. The tests were made by immersing flasks of the glass in mercury and filling up the interior with mercury. The mercury formed electrodes to convey the current from 120 Daniell cells through the glass; and the resistance was measured by a high resistance astatic galvanometer. They found that the resistance of the glass increased with the percentage of lead in the glass, and also with the density, but diminished as the percentage of alkali in the glass increased. The best specimen tried contained over 40 per cent. of lead oxide, and had a density of 3.141. Its specific resistance at a temperature of 130 deg. Cent., was $8400 \times 10^{10}$ ohms between two opposite faces of a centimeter cube. The experiments show that the resistance of glass is halved by an increase of about 8½ deg. Cent. This rule holds for a considerable range of temperature, hence the approximate resistance of glass at a certain temperature may be estimated. In taking the temperature observations, the glass flasks were heated by means of a sand bath.

The Companhia Portuguesa Electricidade has been formed at Lisbon, with a capital of 2,500,000 francs, to supply electric light. A central station will be erected, and it is said that the company already have orders on hand.

## Telephonic News

⁂ It is said that the New England Telephone Company will shortly increase its suburban telephone rentals.

⁂ There has been trouble in the telephone exchange at Mazatlan, Mexico, growing out of poor management. At last advices it was temporarily in the hands of the American consul, pending the arrival of an agent from New York.

⁂ The New England Telephone Company shows the net gain in subscribers by months since January 1, as follows:

NET GAIN.

| | |
|---|---|
| January | 459 |
| February | 183 |
| March | 185 |
| April | 130 |
| May | 252 |
| June | 229 |
| Gain for six months | 1,438 |

⁂ Servia boasts one telephone line, one kilometer long, connecting the Ministry of the Interior and the Prefecture at Belgrade. Bulgaria and Luxembourg do not believe in the telephone; at all events, they have not a yard of line at work at present. Turkey has three lines, one used by the Administration of Telegraphs, the second used at a life-saving station on the Black Sea, and the third belonging to the Eastern Telegraph Company and the Ottoman Bank. The above lines represent a total length of wire of 41 kilometers.

⁂ At the Exhibition next month, one of the most instructive departments will be that devoted to telephones. This exhibit will be very thorough, and will, as previously stated, include models of the earliest inventions in the art of "far-speaking." An interesting feature for out-of-town visitors will be a completely equipped exhibit of the "central station" system of telephoning, as used in large cities. During the Exhibition, it is hoped to make some experiments in long-distance telephoning, when probably Philadelphia will talk with Boston and Chicago.

⁂ It is evident that the telephone has not interfered with the development of the telegraph in England. The annual report shows that the number of messages was 32,843,120 against 32,092,026 in 1882-83, and 31,345,861 in 1881-82. The increase is pretty evenly distributed over the English provinces (14,910,413 against 14,554,015 in 1882-83), London (12,686,433 against 12,374,707), Scotland (3,299,828 against 3,244,202), and Ireland (1,936,846 against 1,919,102 in 1882-83). The royalties among telephone companies are contained among miscellaneous receipts, which have been swollen to £32,179 in the last year, against £29,517 in 1882-83, £25,090 in 1881-82, £13,737 in 1880-81, and £9,769 in 1879-80. The increase in the rentals for private wires—£94,953, against £84,429 in 1882-83, £72,481 in 1881-82, and £67,747 in 1880-81—is also chiefly due to the development of the private telephone systems.

The working of the telephone systems in France has been secured for a further period of five years. The Minister des Postes et des Telegraphes has granted a concession to the Societe Generale des Telephones for the working, during that period, of the systems founded by that company. This concession has been granted in conformity with the bill introduced by the Minister, and it is stated that the details are based on the terms of the previous concession, according to the principles laid down by the parliamentary committee on this question. The principal changes which are contained in the new concession are such as to define more clearly the prospective position of the French Government and the Company in case of the purchase of the installations by the former. Certain developments now considered necessary are also said to have been granted, such as the extension of the system in the suburbs of cities, the permission of the public to speak to subscribers through public telephone stations, etc. We shall shortly be in a position to give full details of the facilities conceded, which are of especial interest, in view of a similar arrangement now pending between the Postmaster-General and the telephone companies in this country.

### Kansas City and Northwestern News.

KANSAS CITY, MO., August 16.—The General Superintendent of the Missouri & Kansas and United Telephone Companies informs me that he finds the demand for telephones throughout his territory still increasing. This is very pleasing to him, as it would be to any telephone man in a like position, as long as the demand comes from cities and towns where exchanges have been established; but when small towns of from 2 000 to 5,000 inhabitants come to the front full of telephonic enthusiasm, and ask that an exchange be established forthwith, you will find the telephone superintendent of experience scratching his head and thinking a while. As long as the enthusiasm and town pride hold out (which sometimes is until the yearly contract expires) small exchanges of from thirty to seventy-five may be maintained in these places; but in about one year from date of opening the exchange, unless the town has made remarkable growth, or has a number of long line connections with adjoining cities, the subscribers commence to drop out, claiming to appreciate the many advantages of the telephone, but also stating that they haven't business enough with neighboring business houses—all of which are probably within a stone's throw—to justify their keeping a telephone; and as a result of such reasoning, telephone companies, with perhaps more enterprise than sagacity, find themselves with plants on their hands that either have to be closed up or run at no profit—sometimes at a loss—hoping for better things. It is not pleasant to refuse to build an exchange when thirty of the leading citizens of a little town of 3,000 inhabitants ask it; but experience has taught all, or nearly all, telephone companies that such ventures are much more apt to prove failures than blooming successes. If some of the thirty above mentioned should happen to see these lines, they may understand why telephone companies lack enterprise, so called. But there is a healthy growth in nearly all the western exchanges, and in the larger cities the telephone is now pronounced indispensable to the business interests.

There have been several changes in telephone circles of the West recently, the force of the general officers of the Missouri & Kansas, the United, and the Colorado Telephone Companies being reorganized. In all cases all the old and experienced telephone men were recognized, an indication that civil service reform is an element with the controlling powers in telephone circles. Since Mr. Vaille, of the Colorado Telephone Company, resigned to move to his eastern home, Mr. E. B. Field, at the time superintendent of the operating department, and a bright young telephone man, has been acting manager. At a recent meeting of the board of directors in Denver, Mr. Field was unanimously made general manager, his past success in handling the property of the company proving his capacity for the more responsible position. Mr. Field will be warmly congratulated on his deserved promotion by the fraternity generally. Mr. W. W. Smith, of Indianapolis, who for several years past has been prominently identified with the Central Union Telephone Company, has accepted the position of general superintendent of the Missouri & Kansas and the United Telephone Companies, with headquarters at Kansas City, and has for his staff E. L. Smith, general superintendent of both companies, and Chas. W. McDaniels, assistant superintendent. The territory that these gentlemen manage comprises all of Kansas and Missouri (excepting St. Louis), as well as the Indian Territory—the last named a locality, it is needless to remark, that hasn't displayed much interest in talking machines, but there is hope for its future. General Superintendent Smith has taken hold with characteristic vigor, and as he brings to his new field a practical knowledge of the telephone business, probably second to none in the West, you may look for an excellent showing in his domain. His assistants are capable and energetic. Mr. Paul W. Bossart, formerly with the United Company, has resigned, and will probably accept a position in the East. Mr. Bossart is quite popular in telephone and telegraph circles, and possesses many friends who will follow him with their best wishes to his eastern home. W. C. Stewart, for several years manager of the telephone exchange at St. Joseph, Mo., has resigned to accept the superintendency of the electric light company of that city. Mr. Chas. M. Davis, formerly manager at Lawrence, succeeds Mr. Stewart, a brother of Mr. Davis taking charge at Lawrence.

The *Journal*, of this city, has the following about a well-known and highly successful telephone man: "George L. Phillips, Esq., president of the Missouri & Kansas and United Telephone Companies, arrived in the city yesterday from an extended western tour. Mr. Phillips is so highly pleased with the push and life of the West, that it is doubtful if his Boston affiliations can prevent his soon becoming a citizen of this booming summer resort."

While on a recent visit to a telephone exchange in Kansas, E. L. Smith, of this city, was surprised to find in one corner of the room a placid looking hen, occupying herself in keeping a nestful of eggs securely covered. Mr. Smith was about to "shoo" her out, but was stopped by the indignant young-lady manager, who informed him that that was her hen, and she didn't want her disturbed, and that she found the Brahma lots of company. The superintendent relented, but has kept the discovery to himself, fearing that all "funny noises" on the wires in that town would be attributed to the clucking of the hen and her brood, or if the operator failed to answer inside of three seconds the subscriber would decide at once that she was feeding her pets. A hen assisting in operating a telephone exchange, and also doing her share of providing spring chickens, is the kind of a hen to have in the family.

Colonel Clowry, general superintendent of the Western Union, was in the city last week, in his special car, inspecting the company's property. A number of the other officials, including Superintendent Baker, Superintendent Dickey, Colonel Bristol, and Electrician Summers, were with the party. They were returning from an extended tour, and while in the city took in the telegraph and telephone offices.

General Superintendent Smith has had the long lines between here and Topeka (70 miles) and here and Atchison (50 miles) carefully trimmed, a couple of linemen with team and tools tracing both lines. They found the tree branches interfering with the lines in many places, and also soldered several connections that had become loose. A noticeable improvement in the working of the lines is observed since this "trimming" process was gone through with.

Shouldn't all electrical journals say a good word for "Magnetic" Blaine? It is hardly "electric," but there is a very "strong current" favorable to him out here, with no "retardation" but considerable "induction" from other "lines," notably the "Cel-tick."

Why is a dog, run over by a street car, like what runs over telephone wires? Because it is a cur-rent. [If the intelligent compositor sets this up, "Because it is a dog cut in two," there will be bloodshed.] BI-POLAR.

Amongst electrical experts, the *Gazette* says, there are those to be found who frankly tell you that their study has been devoted to the electric light exclusively, and that they are, so far as exact electrical knowledge is concerned, very much in the dark as to the telephone. But such men are rare, for, for each who will be thus frank, you will find a dozen who, although exactly the same is true of them, boldly claim to know it all, and profess to have an opinion—and a valuable one—concerning departments of electrical science of which the knowledge is, to put it very mildly, exceedingly limited. As experts, therefore, they are even worse than useless, since they set up to know what they do not, and mislead by their pretended knowledge.

One of the most remarkable telegraphic feats on record was the recent delivery of a message from Melbourne to London in twenty-three minutes. The message went by land and sea over 13,398 miles of wire.

### The New British Standard Wire Gauge.

The makers of wire and sheet metal have, from time immemorial, designated the various sizes, diameters, or thicknesses of their productions by a series of numbers; but the actual size represented by each of these numbers has had no universally accepted value. A multiplicity of so-called standard or gauges have been in existence, and endless confusion and trouble has been the result. Not only do the various standards vary, but different specimens of the same standard, even when made by the same maker, fail to agree together with the accuracy demanded by modern needs.

That which has undoubtedly the greatest currency is known as the Birmingham Wire Gauge, and can be traced back at least as far as the early part of the last century. It consists of a plate having in its edges a series of notches, each marked by a number indicating the thickness of the corresponding plate or wire. These notches have been added or altered as circumstances seemed to require, and together they form a series of sizes in some manner roughly proportionate to one another. Many attempts have been made to harmonize the existing differences, so as to insure uniformity of size and a regular proportion—geometrical or empirical—between the various sizes.

To insure this uniformity of size, it has been repeatedly suggested that the whole difficulty could be obviated by expressing the sizes in thousandths of an inch. This was the conclusion reached by a committee of the American Institute of Mining Engineers, whose "Report on a Standard Wire Gauge" was published in this *Journal*, for February, 1878, and who recommended the micrometer screw caliper as the best known form of measuring device for this purpose. They did not, however, propose any series of sizes which would meet all requirements. For convenience, such a series of sizes must be agreed upon, and these sizes should bear some proportionate relation to one another: it is generally thought that the components of such a series should be most conveniently distinguished in trade by their numbers.

Many such series have been designed, but none of them have secured a universal recognition. Thus, the late Robert Briggs, C.E., proposed a gauge in which the reduction from one size to another should be 10 per cent. in diameter, or 19 per cent. in weight, starting with No. 0 = 1 centimeter. Mr. Latimer Clark proposed a series with the same starting point, but with a reduction of 20 per cent. in weight and 10.557 per cent. in diameter.

In Great Britain the subject has long been discussed, and has of late received new impetus from manufacturers of electrical apparatus, to whom the size of the wire employed is often a vital matter. The feeling in England seems to have been that no gauge differing widely from the Birmingham gauge could be successfully introduced, and many attempts have been made to ascertain the exact sizes of the various numbers, and to modify them slightly, so as to bring the series of numbers up to modern requirements without entirely subverting present practice. This effort has finally culminated in the adoption by the Standard Department of the Board of Trade of Great Britain of a New Legal Standard Wire Gauge, which fixes a definite value for each number of the Birmingham Gauge.

Through the courtesy of Prof. J. E. Hilgard, Superintendent of the United States Coast and Geodetic Survey, we are enabled to present herewith official tables giving the new standards in millimeters and in parts of an inch. Professor Hilgard has also favored us with a series of interesting analyses of the

new and old gauges, which we are glad to have an apportunity of putting on record.

NEW LEGAL STANDARD WIRE GAUGE.

| Descriptive Number. B. W. G. | Equivalent in parts of an inch. | Descriptive Number. B. W. G. | Equivalent in parts of an inch. |
|---|---|---|---|
| No. 7/0 | 0.500 | No. 23 | 0.024 |
| 6/0 | 464 | 24 | 22 |
| 5/0 | 432 | 25 | 20 |
| 4/0 | 400 | 26 | 18 |
| 3/0 | 372 | 27 | 0 64 |
| 2/0 | 348 | 28 | 148 |
| 0 | 324 | 29 | 136 |
| 1 | 300 | 30 | 124 |
| 2 | 276 | 31 | 116 |
| 3 | 252 | 32 | 108 |
| 4 | 232 | 33 | 100 |
| 5 | 212 | 34 | 0092 |
| 6 | 192 | 35 | 84 |
| 7 | 176 | 36 | 76 |
| 8 | 160 | 37 | 68 |
| 9 | 144 | 38 | 60 |
| 10 | 128 | 39 | 52 |
| 11 | 116 | 40 | 48 |
| 12 | 104 | 41 | 44 |
| 13 | 92 | 42 | 40 |
| 14 | 80 | 43 | 36 |
| 15 | 72 | 44 | 32 |
| 16 | 64 | 45 | 28 |
| 17 | 56 | 46 | 24 |
| 18 | 48 | 47 | 20 |
| 19 | 40 | 48 | 16 |
| 20 | 36 | 49 | 12 |
| 21 | 32 | 50 | 0010 |
| 22 | 28 | | |

11,367.—500.—2/84 Wt. 2,3838. E. & S.

NEW LEGAL STANDARD WIRE GAUGE.

| Descriptive Number. B.W.G. | Metric equivalent in milli-meters. | Descriptive Number. B.W.G. | Metric equivalent in milli-meters. |
|---|---|---|---|
| | m.m. | | m.m. |
| No. 7/0 | 12.700 | No. 23 | 0.610 |
| 6/0 | 11.785 | 24 | 0.559 |
| 5/0 | 10.973 | 25 | 0.508 |
| 4/0 | 10.160 | 26 | 0.457 |
| 3/0 | 9.449 | 27 | 0.4166 |
| 2/0 | 8.839 | 28 | 0.3759 |
| 0 | 8.229 | 29 | 0.3454 |
| 1 | 7.620 | 30 | 0.3150 |
| 2 | 7.010 | 31 | 0.2946 |
| 3 | 6.401 | 32 | 0.2743 |
| 4 | 5.893 | 33 | 0.2540 |
| 5 | 5.385 | 34 | 0.2337 |
| 6 | 4.877 | 35 | 0.2124 |
| 7 | 4.470 | 36 | 0.1930 |
| 8 | 4.064 | 37 | 0.1727 |
| 9 | 3.658 | 38 | 0.1524 |
| 10 | 3.251 | 39 | 0.1321 |
| 11 | 2.946 | 40 | 0.1219 |
| 12 | 2.642 | 41 | 0.1118 |
| 13 | 2.337 | 42 | 0.1016 |
| 14 | 2.032 | 43 | 0.0914 |
| 15 | 1.829 | 44 | 0.08 3 |
| 16 | 1.626 | 45 | 0.0711 |
| 17 | 1 422 | 46 | 0.0610 |
| 18 | 1 219 | 47 | 0.0508 |
| 19 | 1.016 | 48 | 0.0406 |
| 20 | 0.914 | 49 | 0.0305 |
| 21 | 0.813 | 50 | 0.0254 |
| 22 | 0.711 | | |

R 9181.—2.

The table below presents the values that have been adopted by Act of Parliament for the new British Legal Standard Wire Gauge.

| Descriptive Number. B.W.G. | Equivalent in parts of an inch. | Differences. | Descriptive Number. B.W.G. | Equivalent in parts of an inch. | Differences. |
|---|---|---|---|---|---|
| No. 7/0 | 0.500 | 0 036 | No. 23 | 0.024 | 0.002 |
| 6/0 | 464 | 32 | 24 | 22 | 2 |
| 5/0 | 432 | 32 | 25 | 20 | 2 |
| 4/0 | 400 | 28 | 26 | 18 | 16 |
| 3/0 | 372 | 24 | 27 | 164 | 16 |
| 2/0 | 348 | 24 | 28 | 148 | 12 |
| 0 | 324 | 24 | 29 | 136 | 12 |
| 1 | 300 | 24 | 30 | 124 | 8 |
| 2 | 276 | 24 | 31 | 116 | 8 |
| 3 | 252 | 20 | 32 | 108 | 8 |
| 4 | 232 | 20 | 33 | 100 | 8 |
| 5 | 212 | 20 | 34 | 92 | 8 |
| 6 | 192 | 16 | 35 | 84 | 8 |
| 7 | 176 | 16 | 36 | 76 | 8 |
| 8 | 160 | 16 | 37 | 68 | 8 |
| 9 | 144 | 16 | 38 | 60 | 8 |
| 10 | 128 | 12 | 39 | 52 | 4 |
| 11 | 116 | 12 | 40 | 48 | 4 |
| 12 | 104 | 12 | 41 | 44 | 4 |
| 13 | 92 | 12 | 42 | 40 | 4 |
| 14 | 80 | 08 | 43 | 36 | 4 |
| 15 | 72 | 8 | 44 | 32 | 4 |
| 16 | 64 | 8 | 45 | 28 | 4 |
| 17 | 56 | 8 | 46 | 24 | 4 |
| 18 | 48 | 8 | 47 | 20 | 4 |
| 19 | 40 | 4 | 48 | 16 | 4 |
| 20 | 36 | 4 | 49 | 12 | 3 |
| 21 | 32 | 4 | 50 | 10 | |
| 22 | 28 | 4 | | | |

It will appear at first glance that this is the Birmingham or Stubs' gauge, considerably simplified. In that the numbers representing the different sizes are in a majority of cases prime to each other, and simple exact ratios impossible. In the new gauge all the numbers, as given in the table, with three exceptions, are multiples of 4, and it is possible for one gauge to be exactly double some other. This occurs in nineteen cases, beginning with Nos. 6/0 and 4 and ending with Nos. 47 and 50. There is, of course, an approximation to this ratio in many other cases, but the limitations of the problem seem to prevent a greater number of exact agreements.

The figures in the third column of the table show how much less each following number is than the preceding. Here also there is a progression by 4s (with the exceptions noted above), though the number of times that each number enters is governed by no law, 36 entering once, and 8 fourteen times.

| Descriptive Number. | New Led. Std. | Birming-ham. | D. B. & S. |
|---|---|---|---|
| 0000000 | 0.500 | | |
| 000000 | 464 | | |
| 00000 | 432 | | |
| 0000 | 400 | 0.454 | 0.46 |
| 000 | 372 | 425 | 40964 |
| 00 | 348 | 380 | 3648 |
| 0 | 324 | 340 | 32495 |
| 1 | 300 | 300 | 2893 |
| 2 | 276 | 284 | 25763 |
| 3 | 252 | 259 | 22942 |
| 4 | 232 | 238 | 20431 |
| 5 | 212 | 220 | 18194 |
| 6 | 192 | 203 | 16202 |
| 7 | 176 | 180 | 14428 |
| 8 | 160 | 165 | 12849 |
| 9 | 144 | 148 | 11443 |
| 10 | 128 | 134 | 10189 |
| 11 | 116 | 120 | 90742 |
| 12 | 104 | 109 | 80808 |
| 13 | 92 | 95 | 71961 |
| 14 | 80 | 83 | 64084 |
| 15 | 72 | 72 | 57068 |
| 16 | 64 | 65 | 5082 |
| 17 | 56 | 58 | 45257 |
| 18 | 48 | 49 | 40303 |
| 19 | 40 | 42 | 3539 |
| 20 | 36 | 35 | 31961 |
| 21 | 32 | 32 | 28462 |
| 22 | 28 | 28 | 25347 |
| 23 | 0.024 | 0.025 | 0.22571 |
| 24 | 22 | 22 | 201 |
| 25 | 20 | 20 | 179 |
| 26 | 18 | 18 | 1594 |
| 27 | 164 | 16 | 14195 |
| 28 | 148 | 14 | 12641 |
| 29 | 136 | 13 | 11257 |
| 30 | 124 | 12 | 10025 |
| 31 | 116 | 10 | 8928 |
| 32 | 108 | 9 | 795 |
| 33 | 100 | 8 | 708 |
| 34 | 92 | 7 | 6304 |
| 35 | 84 | 5 | 5614 |
| 36 | 76 | 4 | 5 |
| 37 | 68 | ..... | 4453 |
| 38 | 60 | ..... | 3965 |
| 39 | 52 | ..... | 3531 |
| 40 | 48 | ..... | 3144 |
| 41 | 44 | | |
| 42 | 40 | | |
| 43 | 36 | | |
| 44 | 32 | | |
| 45 | 28 | | |
| 46 | 24 | | |
| 47 | 20 | | |
| 48 | 16 | | |
| 49 | 12 | | |
| 50 | 10 | | |

Above are placed, side by side, the new scale, the Birmingham scale and the Darling, Brown & Sharpe scale, the values being given in fractions of an inch.

By comparison of the first two scales it will be seen that for the old series of four sizes from 0000 to 0 is substituted a series of seven sizes from 0000000 to 0, the first lying entirely outside the old series, and being exactly ½ inch. At No. 1 there is agreement between the two scales, the value being 0.3 inch. From this point to No. 30 there is substantial agreement. The six sizes following No. 30 in the old series range from 0.1 to 0.004. To these correspond twelve sizes in the new. The last eight numbers in the new series have no counterpart in the old.

It may be of interest to state the progress made by the telephone in some of the more remote countries of Europe. Thus we find that the Turkish telephone service, which was introduced into that country in 1880, comprises three systems, of which one is exclusively devoted to the official service of the Telegraph Administration, a second to the life-saving service in the Black Sea, and the third to that of the Eastern Telegraph Company and the Banque Ottomane. On January 1, 1884, the whole of these three systems represented an extent of forty-one kilometers of wire. The number of telephone stations is eight, each served by an instrument. The Black, Gower, and Ader telephones are used. Until now no public telephone service has yet been established in Turkey.

In Spain the organization of telephonic communication has formed the object of several bills submitted by the Telegraph Administration, but no act has as yet been passed or Government regulation issued bearing on the mode of working this new service, so that no proper public telephone service can be said to exist. In the cities of Bilbao and Valencia telephone systems have been established, but solely for the use and at the expense of the municipalities. There are also military telephone systems at Valencia, Saragossa, Carthagena, and Madrid, and in the latter city a second system for the ministries. In these different cities, and in others, a number of merchants have established telephonic communication between their private houses and offices, or between their town houses and villas in the country. But these connections are intended for the exclusive use of the proprietors None of the lines are longer than ten kilometers.

In Servia one telephone line only, of one kilometer in length, is in existence, the cost of which is 476 francs. It connects the Ministry of the Interior with the Prefecture of Belgrade, and is only intended for official use.

In Bulgaria and Luxemburg no telephone communication is in existence. In the latter country the introduction of the telephone is being discussed, and the administration hopes shortly to organize a public service in the capital and suburbs. It is also intended to extend certain lines of the telegraph system into the country and to use them for telephoning.

Among other interesting things to be exhibited at the Electrical Exposition will be relics from the workshop of Professor Henry, whose name is identified with the earlier history of telegraphy, and a large number of models from the United States Patent Office of inventions which have since become famous. It is probable that the original Morse instruments, now in the possession of the Smithsonian Institution, will also be shown. The models will represent all the earlier forms of telephones, telegraph instruments, electric lights and all the inventions of Grey, Bell, Edison, and others. Nearly all of this collection will, of course, be loaned.

The whole subject of telegraphy will be exhaustively illustrated by the exhibition, which will include every kind of machinery, insulating materials, wires, cables, instruments, relays, batteries, and a complete exposition of the duplex, quadruplex and multiplex systems, by which seventy-two messages have been recently sent simultaneously over a single wire between Boston and Providence. This department will also include signaling apparatus for railways, and for registering at a distance pressures and temperatures. In electric lighting there will be illustrations of the various methods of generating the current from steam power by dynamos, and the use of the current by the incandescent and the arc systems, both of which will be represented by all the leading companies which make a business of electric illumination. The various arc light companies will light the building in turn, thus affording comparative tests of their excellence; while the incandescent systems will be shown in rooms darkened by board partitions. The so-called "storage" batteries of various patterns will also be shown in actual operation.

Reports from Mazatlan are that two large mines are already using the electric light, and two more are introducing it.

## TELEGRAPHIC

.... Telegraphic communication has been established between Fernandina, Fla., and Jacksonville direct, along the line of the Fernandina and Jacksonville Railroad. Trains on that road will be run now as on the main line, under telegraphic orders.

.... New South Wales has made rapid progress in electric telegraphy. In 1873 there were but 6,521 miles of wire, 105 telegraph stations, and 365,360 messages sent. In 1882 the mileage had increased to 15,901, the stations to 345, and the number of messages sent to 1,965,931.

.... The Spanish General-Director of Posts and Telegraphs invites tenders to be opened on August 18, at Madrid, for the delivery of 200 tons of galvanized iron wire, 150 tons of 4 mm., 50 tons of 5 mm. diameter (estimate per ton 650 rup. 600 pesetas); on August 20, 60,000 insulators (estimate 1.20 pesetas each), and 10,000 small bearers of galvanized iron (estimate 1.20 pesetas each), deposit 5 per cent. of the value; on August 22, a number of telegraph apparatus, deposit 5 per cent. of the value. Particulars may be had of the Director, Strada de San Riocardo 3, at Madrid.

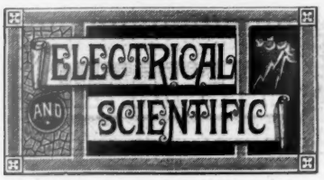
AUSTIN, TEX., Aug. 8, 1884.

*Editors Electrical R view:*

The inclosed article is going the rounds of the press, and is calculated to deceive. The Baltimore and Ohio, as yet, have no outlet north or east in Texas, and will have to build several hundred miles to get one. Neither has the Gulf, Colorado and Santa Fe a line of their own to San Antonia or Austin. Should they get connection with the two latter points, they will have to build at least 200 miles of wire. The Santa Fe connect so far with but few points of any consequence, and additional wires will have to be added for commercial business. X.

A SOUTHERN FEEDER FOR THE B. & O.

An important contract was made between the Baltimore and Ohio Telegraph Company and the Gulf, Colorado and Santa Fe Railway Company here last week, which will open up for competition nearly the entire State of Texas. The Gulf, Colorado and Santa Fe Railway have wires already in operation between Galveston, Houston, San Antonio, Austin, Dallas, Fort Worth and other important towns, which will be connected within two or three weeks with the Baltimore and Ohio Company's lines already in operation to Texarkana. No opposition telegraph company has ever before reached that important territory, and the prospects of competition are gladly welcomed by the citizens of Texas generally. Mr. David Hall, a prominent telegrapher, with many years of experience in Texas, formerly manager of the Western Union at Galveston, has been appointed superintendent of the newly-acquired territory. Mr. Hall left this city last Friday for the purpose of putting the work of additional construction under immediate progress. The necessary material, poles, wire, etc., have already been shipped to construct the lines between Texarkana and Paris, and between New Orleans and Houston, it being the purpose of the Baltimore and Ohio Telegraph Company to give the State of Texas two outlets to the North and the East. The railway company has already begun to add additional wires on their lines, and within two months ample facilities will be provided to all points in the far Southwest, it being the purpose of the Baltimore and Ohio Company to extend their system south to a connection with the Central American cable system. Very high tariffs have hitherto obtained to points in Texas, which will be largely reduced by the advent of the new company, and a severe blow will be dealt by this combination to the Western Union.




* * The preparations for M. Deprez's experiments on the transmission of power between Creil and Paris are being actively carried on. The preliminary work is finished, and the two engines which are to supply the motive power are already in place at Creil.

* * The United States Senate has appropriated $224,556 to cover the expense of running a boundary, of 1,700 miles in length, between this country and Mexico, as required by the convention of July 29, 1882. This boundary is to be marked by permanent mile posts.

* * From experiments by M. E. Mercadier on rods of steel and iron held at two points, it appears that the number of vibrations is proportional to the thickness in the direction of the displacement, inversely proportional to the square of the length, and independent of the breadth.

* * Professor Herbert Macleod, of Cooper's Hill Engineering College, has devised a simple and effective sunshine recorder by merely placing a globular bottle of water (or water lens) in front of the lens of a camera, in such a position that the focussed ray falls on a sheet of sensitized paper spread on the bottom of the camera box. A curved white line or band is produced on the paper as the sun revolves, and when clouds cross the sun the line stops.

* * Professor Tait, of Edinburgh, insists that when people think they see a lightning flash go upward or downward they must be mistaken. The duration of a lightning flash is less than the millionth part of a second, and the eye cannot possibly follow movements of such extraordinary rapidity. The origin of the mistake seems, he says, to be a subjective one, viz., that the central parts of the retina are more sensitive by practice than the rest; and, therefore, that the portion of the flash which is seen directly affects the brain sooner than the rest. Hence a spectator looking towards either end of the flash very naturally fancies that end to be its starting point.

* * An international exhibition of motors and tools has been opened at Vienna. Its object is to promote improvements and the development of small trades by showing how they can compete with large manufacturers. All the new appliances in lighting will be exhibited, including two great Siemens regenerators. Gas burners of 2,000 candle-power each are placed in the gallery of the main hall, and other rooms will be illuminated by incandescent and arc lamps, and by gas lamps of various construction. Several English firms are among the exhibitors.

* * At the last meeting of the French Academy of Sciences M. Bouquet de la Grye communicated the results he had obtained at Puebla with a multiplying seismograph. The friction of the parts of this apparatus is so small that the heat of the hand produces a movement of the indicating needle. Results obtained during November and December, 1882, show that the sun and the moon have a direct action on the pendulum. The moon attracts it, the sun has an inverse effect. By its means twenty-two abnormal movements were noted during one month, which were probably due to seismic causes. One of them only was felt in the town of Puebla.

* * The Johns Hopkins University announces a special course of lectures on molecular dynamics, to be delivered at Baltimore by Sir William Thomson, F. R. S., Professor of Physics in the University of Glasgow, Scotland. Professors and students of physics from other institutions are invited by the University to attend. A registration fee of $5 is required from such persons as follow the course, unless they are in other ways connected with the University. The introductory lecture will be given on Wednesday, October 1, and the other lectures will follow on consecutive days; there will be 18 in all. Arrangements will be made for the temporary lodging of students from other institutions, provided an early intimation is received of their intention to attend the lectures.

* * Sir H. Tyler has made an interesting calculation, from which he finds that no less than 230 overhead wires may be counted between the Royal Exchange and St. Michael's Church, Cornhill, and 200, more or less, between the Mansion House and Queen street, the latter being stretched across Queen Victoria street. A few days since he called the attention of the Secretary of the Local Government Board to these figures. In his reply this gentleman pointed out that out of the 230 only six belonged to the post-office, and out of the 200 only four. He further stated that it was under consideration whether a select committee of the House of Commons should be moved for next session, to inquire into and report upon the subject of overhead wires. We have recently seen it stated in a contemporary that "overhead wires serve to dissipate the electricity in the atmosphere, and thus protect cities from lightning." Do they? We should be glad if the paper in question would kindly substantiate its statement.—*London Electrician.*

* * The following list of contractions, which have been adopted by the International Metrical Congress at Paris, and recommended for general use, may be found serviceable for reference: (1) Length—Kilometer, *km;* meter, *m;* decimeter, *dm;* centimeter, *cm;* millimeter, *mm.* (2.) Surface—Square kilometer, *km2;* square meter, *m2;* square decimeter, *dm2;* square centimeter, *cm2;* square millimeter, *mm2;* hectare, *ha;* are, *a.* (3.) Cubic measure—Cubic kilometer, *km3;* cubic meter, *m3;* cubic decimeter, *dm3;* cubic centimeter, *cm3;* cubic millimeter, *mm3.* (4.) Hollow measure—Hectoliter, *hl;* liter, *l;* deciliter, *dl;* centiliter, *cl.* (5.) Weight—Ton (1,000 kilogrammes), *t;* metric hundredweight (100 kilogrammes), *q;* kilogramme, *kg;* decagramme, *dkg;* gramme, *g;* decigramme, *dg;* centigramme, *cg;* milligramme, *mg.* Italics are used for these contractions, but no period (.) is used after them, and they succeed the figures to which they refer. Fortunately, no "sorts" besides the "*m2*" and "*m3*" are requisite. Roman might do as well as italic characters, however, and subserve typographical neatness. It is satisfactory to note that the absurd freak of placing decimal fractions with their points after the designations, instead of immediately after the integers, is deservedly discountenanced. Writers on scientific subjects are sometimes far too prone to affectations in manuscript, which hardly promote either accuracy or intelligibility, but are a positive imposition on the time, patience, and temper of editors and printers.

* * The first meeting in America of the British Association for the Advancement of Science will open in Montreal on the 27th instant. Doubt had been expressed whether members in sufficient numbers would be willing to cross the ocean to make the meeting successful; but the plan has found unexpected favor, and a large attendance is assured, including many of the best-known British scientists, of whom several have already personal acquaintance with America. A cordial invitation has been extended to members of the kindred American association to be present and to take part in the exercises at Montreal; and it is expected that the British visitors, after the close of their meeting, will attend that of the native scientists at Philadelphia. The outcome of the two meetings, so close together, is likely to be the constitution of an international association, which will knit closer the relations between scholars of both continents and promote, by their intercourse, the general cause of learning. The subjects for discussion by the various sections at Montreal have been arranged, so far as possible, to cover fields appropriate to America. Among them we note "Deep Sea Life, Animal and Vegetable," in which study our official commissions have taken a foremost place; "The Native Races of America;" "Civilization of America Before the Time of Columbus, with Reference to Earlier Intercourse with the Old World;" "Archæology" and "Native Languages" of America. We tender a hearty welcome to the scientists of England, Ireland, and Scotland, and we hope that this visit will be followed by many others. The presence of the distinguished guests will doubtless receive appropriate recognition in Philadelphia, and we trust that means will be found not to allow it to pass without notice in New York.

* * The arrangements are nearly completed for the great meeting of the American Association for the Advancement of Science, in Philadelphia, next month, to which the members of the British Association, and delegates from scientific societies all over the world, have been invited. The American organization will be the guest of the city. It has invited especially the British Association to join in its deliberations, together with the Royal Society of Canada, a young but vigorous institution. In honor of the occasion, it has also invited the National Academy, as well as various local organizations, as the American Institute of Mining Engineers, the Medical Society of New Jersey, the Collegiate Alumnæ and others, to join in bidding welcome to the foreign societies and delegates.

A condensed summary of the exercises follows:

Academy of Music, September 4, 10 A. M., Professor J. P. Lesley in the chair. Governor Pattison and Mayor Smith will welcome the association. In the evening, in the same building, there will be a lecture, not yet announced.

Friday evening, September 5, at the Academy of Music, Professor Young, the retiring president, will deliver an address, after which a grand reception to the foreign delegates will be held, the parquet being boarded over for this purpose and music provided.

Saturday, excursions will be given in various directions for the visitors.

Monday—In the evening the botanical section of the Academy of Natural Sciences will invite those of the visitors interested in this branch, while several citizens of the city will give private receptions to different groups of the visitors.

Tuesday evening a reception will be given by the Biological and Microscopical section of the Academy of Natural Sciences. At the same time another lecture, as yet unannounced, will be given at the Academy of Music. At 9 P. M. a grand reception will be given by the local committee in the Academy of the Fine Arts.

Wednesday the ladies' committee will give a *fête champtère* in the grounds of Haverford College. This evening is set apart also by the managers of the International Electrical Exhibition for a visit by the foreign scientists.

On Thursday evening the meeting will terminate with exercises in the Academy of Music.

Indications point to the assembling of about 1,500 members and associates of the American Association. Up to the present time 175 members and associates of the British Association, and 11 delegates from other foreign societies, have signified their intention of being present. The number of delegates of foreign societies who intend to be present will probably be much greater than this latter number. Nineteen members of the British Association will be accompanied by their wives, and nine ladies will come alone.

Thus far, 29 of the 175 have been offered private hospitality, including four gentlemen and their wives and four ladies alone. A list of names supplemental to that recently published will be made soon, and it is requested that those who desire to entertain any in the list will communicate with Dr. Frazer, the secretary of the committee on invitation and reception, at 201 South Fifth Street. Among the scientists who have recently announced their intention of attending the meeting are Kikuchi Riga Kubucho, of Tokio, Japan; Dr. David Murray, Rev. Dr. S. W. Lyle and Percival Lounde, of the Asiatic Society, of Japan; Major J. Waterhouse, of Calcutta, and Professors Joubert and Silva, of France.

## The Psycho-electrograph.

### ANOTHER "WONDERFUL DISCOVERY" IN TEXAS.

Time must be very plentiful in Texas. It always was a fun-loving State. The latest phase of its mirthfulness is shown in the tendency of its scientific minds to indulge in hoaxes. The following is the gist of the latest Texas hoax, which appears in the Fort Worth *Gazette*, and certainly does credit to the ingenuity of the author. Lots of sober-minded Texans were taken in by it, and some of them have been communicating with electrical experts about it. We take the following extracts from the alleged "interview."

"I took up the idea that the mind, though invisible, is a real tangible something, not to the outward senses of course, but science recognizes the presence of bodies which can neither be seen nor felt, and therefore the mind can exist without manifesting itself to the touch or sight. It certainly has the power to control the tongue, locomotion and the movement of any portion of the body; we all admit this. Crush out or destroy the mind, or the soul, if you please, and the body is immovable; not because it has necessarily lost any of its strength, since the same muscles and tendons remain, but because it has lost the controlling power to enforce obedience—the engine is still there, but the fire is out and the boiler is dry. Now, the secret of my invention is in the selection and preparation of a surface sufficiently sensitive to receive and sufficiently durable to retain the impress of insubstantial substances, if you permit, the ambioloquy. I have prepared a disk—several kinds of them, in truth—and when prepared I place it in a glass globe, through which runs a wire connecting with the disk. The globe is then hermetically sealed, and by the assistance of an air pump—but come here and I will demonstrate as I go along," said he, leading me over to the other end of the room and unveiling a globe arranged after the fashion of those used in schools, and connected at various places with a myriad of fine copper and platina wires. "Here, by the aid of this pump, I exhaust the air entirely from the globe, so the prepared disk has absolutely nothing to disturb it. Then I place my 'subject' standing on that metal platform (pointing to one about a foot square), which is connected to the polar end of a small Leclanche battery. This spongy-looking tassel is composed of very fine wire, which runs through the glass globe, the disk, and on around until it connects with the negative end of the battery; so that when the feet, moistened, are in contact with the metal base, and the head with the tassel, the circuit is complete, and the current flows through the interposed body and on through the globe. If you know anything about electricity you know that the positive pole of a battery is an active, pushing, go-ahead fluid. Consequently you will observe that a charge passing through that disk on a copper wire will spread over its surface uniformly and contemporaneously."

"I think I see that, but I am anxious to know just how you picture the thoughts on that disk."

"Oh, you anticipate me. Well, the manner in which it is done is to concentrate the thought about the brain in the most intense contemplation possible, of the desired object, and, when the mind is thoroughly concentrated, the connection is formed beween the subject's feet where the positive current enters, and rushes through the body and brain to seek an outlet on the wire tassel pressed against the crown of the head, whence it flows on through the glass globe, carrying with it the accumulated fund of concentrated thought, and spreading it over the disk in the vacuum. There are several processes to be gone through with before the disk reveals to the naked eye the image of the thoughts transferred to it, but it requires only a short time, and, if you desire, I have everything in readiness, and you can try it."

The reporter had heard and read so much about practical jokes played with electricity that he hesitated, but the artist's face was too serious and sincere, and he determined to try. What to think of was the question;

what to concentrate the mind on, to give the instrument a fair test. 'Twas easy to conjure up images, but they were fleeting, changing, insubstantial things, that the mind changed in appearance with kaleidoscopic rapidity. Finally the idea of Ben Butler occurred, and from its very absurdity remained. Yes, there was Ben, natural as life, but he would persist in holding before the mental vision a handful of spoons. It was ridiculous, and the reporter regretted he could not select another subject, for he was really in earnest. Finding it useless he rallied and fixed his mind on the hero of Tewksbury with all the concentration at his command, and when ready gave the word.

Down came the wire tassel on his sweating bare head; the soles of his bare feet burnt as if standing on a hot stove; the body was thrilled a moment and shocked considerably, and all was over.

My friend carelessly hung the tasseled cord on a nail after disconnecting it from the globe; turned a spigot and pumped the globe full of a bluish liquid which submerged the disk, and after letting it remain a few minutes took it out and into an adjoining room, where he submitted it to other immersions in various fluids, and finally, bringing it to the light, disclosed the most exact picture of the object of my thoughts. The reporter must confess his astonishment, but there was no disputing the fact that the thought had been pictured most faithfully.

"You said your original idea was to invent a system of electro-stenography. Did you succeed?"

"Not at all," said he, laughing; "but I am not the first that builded greater than I knew. Doubtless you have often started to write a paragraph and ended with a column article. Several writers have told me they have frequently had to change the heading of an article on account of branching out different from their original intentions."

"Tell me," inquired the reporter, "to what use you will put your invention."

"As I said before, I cannot say. As a means of extorting the inner thoughts, however, it will be of the most infinite importance to painters who dream of pictures which escape their memory when they attempt to reproduce them on canvas; it will be of like importance to poets who often have thoughts 'too pure for the touch of a word,' which by this process they can materialize and transfer to paper at their leisure. As an auxiliary to science you can imagine what an assistance it will be to those who labor for years to produce the drawing of an invention which by this can be done in an instant, and I could enumerate a thousand other ways from which to derive a benefit. I will mention one more, and that is in extorting confessions from guilty persons. Say, for instance, you apply it to a murderer. If he is guilty he certainly cannot dismiss the subject from his mind, and you will find it there faithfully represented just as he recollects it. Don't you think that alone should commend it to the good wishes of the public?"

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The industrial progress of the South during the first half of 1884, is shown by the figures furnished by the Baltimore *Manufacturers' Record* to be simply marvelous. These statistics show that nearly $70,000,000 have been invested in Southern Manufactures during the six months ending June 30, divided among the States as follows:

| | |
|---|---|
| Alabama | $13,840,000 |
| Kentucky | 13,497,000 |
| Virginia | 11,032,000 |
| Texas | 7,954,000 |
| Tennessee | 4,840,000 |
| Georgia | 3,759,000 |
| Maryland | 2,832,000 |
| North Carolina | 2,638,000 |
| West Virginia | 2,428,000 |
| Louisiana | 1,830,000 |
| South Carolina | 1,529,000 |
| Florida | 1,506,000 |
| Arkansas | 780,000 |
| Mississippi | 767,000 |
| Total | $60,221,000 |

## The Electric Lighting Act.

The *Pall Mall Gazette*, has been interviewing Mr. Arnold White, late of the Edison Company, on the subject of the Electric Lighting Act.

The failure of the act, Mr. White thinks, "arises primarily from comparing the gas burner which consumes something physical—namely, gas—with the incandescent lamp, which gives something infinitely more subtle—namely, a form of energy. The cardinal principle running through the act, and which vitiates it, in my opinion, is the treatment of electricity as though it were treacle or butter; as though it were ponderable, and could be sold in quantity, while it is obvious that electricity is only known by its effects in light, heat, or power."

When asked by the *Pall Mall* reporter if he had ever made an analysis of how the millions subscribed for electric lighting have been spent, Mr. White replied, "Yes. In 1882 there were sixty-two companies founded, the paid up capital on which was £4,951,575. Since then about £400,000 has been called up, giving a total of £5,351,575 as the amount actually invested since 1882 in the electric lighting enterprise under the Joint Stock Companies Act. I estimate the expenditure of this amount during the past thirty months to have been as follows:

| | £ |
|---|---|
| Promoters, including "patents" | 800,000 |
| Inventors | 115,000 |
| Law and Parliamentary charges | 160,000 |
| Directors' fees | 130,000 |
| Expended on exhibitions and free lighting, undertaken for advertisement | 300,000 |
| Expended on machinery and plant, now mostly obsolete | 270,000 |
| Expended on installations and ship lighting, undertaken mainly at a loss | 1,000,000 |
| Fixed charges, *i.e.*, clerks, secretaries, office rent, advertising, and sundries | 1,250,000 |
| Cash in hand | 500,000 |
| Factories, plant, and stock | 826,575 |
| | £5,331,575 |

"I do not believe that as a going concern the electric light interests now in the hands of the joint stock companies are worth in the aggregate more than a million sterling, and I question whether the profits on the business as a whole, would yield five per cent. dividend on that amount. In support of this opinion I may mention that the paid-up capital of those electrical companies which have obtained a quotation on the London Stock Exchange amounts to £1,289,000, while at the price quoted in the official list of Saturday last, the whole could be bought for £221,880."

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The Cleveland Electrical Street Railway is working most satisfactoaily so far as the use of a single car can test it. The *Herald* of that city says that the machinery for a second car is in place, and the car will be running in a few days, when the interesting experiment of passing two cars, one on a switch and the other on the main track, will be tried. The mechanism to enable this to be done is said to be very simple. It is an automatic arrangement that reverses the currents, much as the electric currents are switched about on the keyboard in a telegraph office. Mr. Knight has no fear but the two cars will run as well as a single one now does. It was not long ago when one electric light was all that could be burned on a circuit. Now 80 lights are burned with ease, and as surely as more than one light on a circuit will burn, so surely more than one car will run. It is difficult to understand how the car now running on the Garden Street extension could be improved. It ran up and down the line yesterday at a speed often exceeding the fastest time of a street-car team. A test of the power of the motor was made the other day, when a second coach was attached to the electric car, and 100 passengers were drawn with ease. The electric current that propels the car has sufficient force to instantly kill the person who handles the wires carelessly, and Mr. Knight states that he has sustained several shocks. He works about the machine with great caution. There cannot be the slightest danger to the passengers, however.

## Power for the New Orleans Exhibition.

Director-General E. A. Burke has accepted the following proposals to furnish engines for the World's Exhibition:

| | No. Engines. | No. H. P. |
|---|---|---|
| W. A. Harris | 1 | 650 |
| W. A. Harris | 1 | 150 |
| E. P. Allis & Company | 1 | 500 |
| Armington & Sims Engine Company | 4 | 500 |
| Westinghouse Engine Company | 2 | 400 |
| Taylor Manufacturing Company | 1 | 200 |
| Smith, Meyer & Schnier | 1 | 200 |
| Novelty Iron Works | 1 | 200 |
| Buckeye Engine Works | 1 | 125 |
| Lane & Bodley | 1 | 75 |
| Jerome Wheelock | 1 | 280 |

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## Dynamos vs. Primary Batteries.

In a letter recently published, Mr. O. C. D. Ross says: "Dynamos and batteries in electric lighting may be compared to the steam-horse and the four-footed animal. For 1,000 lights, or the transport of 1,000 passengers, give me the dynamo and the locomotive; for family, or domestic purposes, the primary battery and a pair of horses in my stable. Each invention has its appropriate place. Engines and dynamos in the outhouse or cellar are sometimes an intolerable nuisance, but a battery can be placed there without the slightest inconvenience. Electric lighting can never become general until more attention is paid to the practical obstacles which have beset its path. Some of the believers in dynamos' would now have the public wait for central stations to be everywhere established, forgetting that, for the supply of only one-quarter of the light now obtained from gas, London alone (as the late Sir William Siemens pointed out) would require 140 such stations, each with from 10 to 15 500 horse-power engines, and innumerable noisy dynamos, erected at a cost of no less than fourteen millions sterling. Householders who do not wish to wait 'it may be for years, or it may be forever,' ask for an alternative, and if the Edison and Swan United Electric Light Company has found that they are not all satisfied with the expedient of a gas engine and dynamo in their own houses, surely no one, it seems to me, should be more interested than that company in the very practical improvements which have been established in primary batteries."

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—— The Edison system is now in use on the stage of the Opera House in Paris.

—— The electric light is a great improvement upon gas in many respects, but nevertheless it has its disadvantages.

It certainly is not so favorable to flirtation; and, judging from the reports that reach us from the fashionable summer resorts, both seaside and mountain, the new illuminator is becoming decidedly unpopular.

Young men and maidens, without exception, frown upon it ominously, as now, even when night approaches, darkness never settles down upon the scene, for grounds and streets are everywhere flooded with electric light.

And so good-bye to whispers in shaded corners or tender looks unseen by any but the one for whom they are meant, when the shameless light sends its searching beams into every nook and cranny, and defines even shadows with such clearness and accuracy as to make concealment impossible.

One thing is sure, either the electric light will have to be abolished, or flirtation will become a lost art, and the courtship lose all its charms.

—— The Halifax Electric Light Company, of Halifax, N. S., has been organized with the following strong board of directors: Robie Uniacke, President Halifax Banking Company; James Thomson, Director Halifax Banking Company; Thos. Bayne, banker; H. F. Worrall, capitalist; Mr. Lee Ross, Manager Royal Electric Company. The capital is $80,000, of which $60,000 will be paid up. The plant, to consist of Thomson-Houston dynamos and lamps, and Armington & Sims' engines, will be furnished by the Royal Electric Company, of Montreal.

## ELECTRIC LIGHT NEWS

—— The Consolidated Electric Light Company have finally decided not to show their system at the Philadelphia Electrical Exposition.

—— The St. John's Electric Light Company has received over $29,000 in actual cash subscriptions, and will start October 1 with its entire plant and buildings paid for in full. Much credit for this is due to the efficient treasurer, Mr. C. A. Stockton.

—— An electric horse chronometer has been invented. The movement is controlled by a current opened and closed by the breaking of an almost microscopic copper wire stretched across the track. It is said to record to the 1,500 of a second.

—— The Thompson-Houston Electric Light Company have nearly completed their new model station at Lynn, Mass. Their plant at the start will consist of four dynamos, driven on the independent system by four Westinghouse automatic engines of 50-horse-power each.

—— A second 50-horse-power engine has been added to the plant of the Saratoga Electric Light Company, which is an offshoot from the American Electric and Illuminating Company of Boston. The glowing burners are seen all along the busy portion of Broadway, in the street and in stores.

—— In the course of two or three weeks an electric light of 24,000 candle-power will illuminate all the dangerous portion of the Hell-Gate approach to New York City. The light is in some measure an experiment, and if it proves a success, as the Lighthouse Board have every reason to expect, a move to place a similar one on Governor's Island will be made.

—— The *Bulletin* of the Compagnie Internationale des Telephones says: "We have received a communication, giving the working cost of the electric lighting installed by the Societe Edison in the grocery shop of Felix Potin. This lighting cost for one month, 6th March to 6th of April, 1884, 357 15f., distributed as follows: Wages, 150f.; lubrication 1 kilo of olive oil per diem, or 26 kilos per month, at 2.66f., 69.15f.; eight lamps, at 6.48f.; coal 100f.—total, 367.15f. The installation comprises 71 incandescent lamps, burning 12 hours per day. The number of hours of lighting was therefore 852 per day, or 28,152 for the month. The lamp hour costs, therefore, 1.7 cent. Further, 3,102 cubic meters of gas were saved, the amount consumed in the same month of the previous year, which at 30c. would have cost 930 60f. Deducting from this sum the 367.15f. expended on the Edison light we have an actual saving of 563.45f."

—— An illustrated description of the new Brush armature has appeared in the *English Mechanic*. The principal feature of this armature is that the laterally projecting portions, between which the wires are wound to form the bobbins, are built up of a series of comparatively thin and distinct metallic plates interposed between the folds of a metallic ribbon, which, when coiled, either alone or in connection with a base ring on which it is wound, forms the annular portion of the armature. Chiefly for convenience in construction Mr. Brush employs the base ring, and coils the band thereon very much as ribbon is spooled; but in the operation of winding he interposes between the coils, on each side of the point or place where bobbins are desired, thin soft metal plates, the ends of which project out laterally beyond the sides of the band-formed ring, a distance equal or about equal to the thickness of the bobbin or bundle of wires to be wound around the band-formed ring, so that both the bobbins and the plates, when the armature is revolved in the machine, shall just clear the pole pieces of the field magnets.

# ELECTRICAL PATENTS

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING AUGUST 12, 1884.

303,261 Cap for telegraph and telephone poles; George M. Broomhall, Paterson, N. J.

303,298 Watchman's time recorder and register; William W. Le Grande, Louisville, Ky., assignor to George Washington Burton, same place.

303,327 Escapement for printing telegraphs; D. Bryce Scott, Brooklyn, N. Y.

303,357 Incandescent electric lighting; Charles F. Beck, Paris, France, assignor to Thomas S Harrison, Philadelphia, Pa.

303,358 Incandescent lamp; Chas. F. Beck, Paris, France, assignor to Thomas S. Harrison, Philadelphia, Pa.

303,399 Electric wire insulator; George Washington Prince, Brooklyn, N. Y.

303,402 Cut-out for electric lamps; Thomas N. Shaw, Pittston, Pa.

303,403 Apparatus for distributing and regulating electric currents; Joseph J. Shinner, Newtonville, Mass.

303,483 Insulator; Charles Le Roy Bailey, Missoula, Mont.

303,496 Method of displaying signs; Lyman H. Day, New York, N. Y.

303,526 Electric railway signal; William W. Le Grande, Louisville, Ky., assignor to the National Electric Railway Signal Company, same place

303,529 Electric battery telephone; Thomas D. Lockwood, Malden, Mass., has been withdrawn.

303,537 Electric connection for railway rails. Robert Meek Louisville, Ky., assignor to the National Electric Railway Signal Company, same place.

303,538 Electrical connecting device for railway rails; Robert Meek, Louisville, Ky., assignor to the National Electric Railway Signal Company, same place.

303,560 Electric battery; Thomas Cleland, New York, N. Y., assignor of one-half to Anna E. Park, same place.

303,567 Magneto-electric railway signal; Wesley W. Gary, Boston, Mass.

303,569 Electric connection for railway rails; Lucius D. Hamilton and Robert Meek, Louisville, Ky., assignors to the National Electric Railway Signal Company, same place.

303,570 Double-acting relay for electric circuits; Lucius D. Hamilton and Robert Meek, Louisville, Ky., assignors to the National Electric Railway Signal Company, same place.

303,589 Electrical signaling apparatus for railroads; Frank L. Pope, Elizabeth N J., assignor to the Union Switch and Signal Company, Pittsburgh, Pa.

303,590 Electric visual signal for railroads; Frank L. Pope, Elizabeth, N. J., assignor to Union Switch and Signal Company, Pittsburgh, Pa.

303,595 Signaling apparatus for railroads; Chas. A. Scott, Boston, Mass., assignor to Union Switch and Signal Company, Pittsburgh, Pa.

RE-ISSUES.

10,508 Telephone switchboard; Everlyn B. Hamlin, Chicago, Ill., assignor by mesne assignments to the Standard Electrical Works.

**A printed copy of the specification and drawing of any patent to the annexed list, also of any patent issued since 1865, will be furnished by any of the patent solicitors whose advertisements appear in this journal. In ordering please state the number and date of the patent desired.**

**If an invention has not been patented in the United States for more than one year, it may still be patented in Canada. Cost for Canadian patent, $40.00. Various other Foreign patents may also be obtained.**


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## BUSINESS NOTICES.

A. C. NORTHROP, Waterbury, Conn. Iron and Brass Machine Screws, Zinc in Sheets and Plate for Electrical Purposes, Parts for Telephone and Telegraph Instruments, Manufactured from Iron, Brass, Steel or Zinc.

A. G. DAY, Kerite Insulated Telegraph and Telephone Wire and Cables, Anti-induction Kerite Telephone Cables, CLARKE B. HOTCHKISS, New York. Send for circular and prices.

ALFRED F. MOORE, Philadelphia, Pa. Telegraph, Telephone, Electric Light, Office, Line and Annunciator Wire.

AMERICAN BELL TELEPHONE Co., Boston, Mass. Electric Speaking Telephones for Exchange Systems, Private Lines, and Speaking-tube Lines.

AMERICAN ELECTRICAL WORKS, Providence, R. I. Patent Finished Insulated Electric Wires, Telephone and Electric Cordage. Electric Light Wire, Magnet Wire, Patent Rubber covered Wire. Aerial and Underground Cables, &c., &c. Send for prices.

AMERICAN INSULATOR COMPANY, New York. Insulators of all sizes.

AMERICAN SPIRAL TELEPHONE WIRE Co., Boston, Mass. Spiral Telephone Wire for long and short distance Telephoning. Write for information.

ARMINGTON & SIMS, Providence, R. I. Engines for Electric Lighting and general use.

AUSTIN GALLAGHER, New York. Keith Electric Light System complete for Arc Lighting. Stock for sale.

BAXTER ELECTRIC LIGHT COMPANY, New York. The Baxter Lamp.

A. M. YOUNG, Waterbury, Conn., Leclanche Zincs. Old style of rod with new connection.

B. W. PAYNE & SONS, Corning, N. Y. The Payne Single and Doubic Valve Automatic Engine. Send for catalogue.

BERGMAN & Co., New York. The Bergman and Hald Battery for Telephone and Telegraph purposes. Send for circular.

BOULTON CARBON Co., Cleveland, Ohio. Carbons for Electric Light purposes. Send for quotations.

BROWNLEE & Co., Detroit, Mich. Telegraph and Telephone Poles.

BRUSH ELECTRIC Co., Cleveland, Ohio. Arc Lights and Brush Storage Batteries.

BUFFALO ELECTRIC WORKS, Buffalo, N. Y. Carbon Points and Plates.

BUTLER HARD RUBBER COMPANY, New York. Rubber Insulators and Electrical Supplies of every description.

C. H. MOORE & Co., Washington, D. C. Solicitors of American and Foreign Patents.

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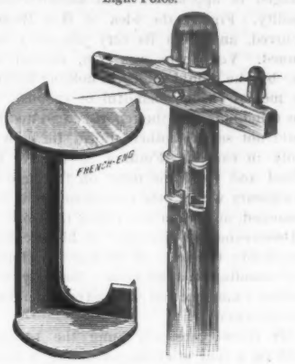


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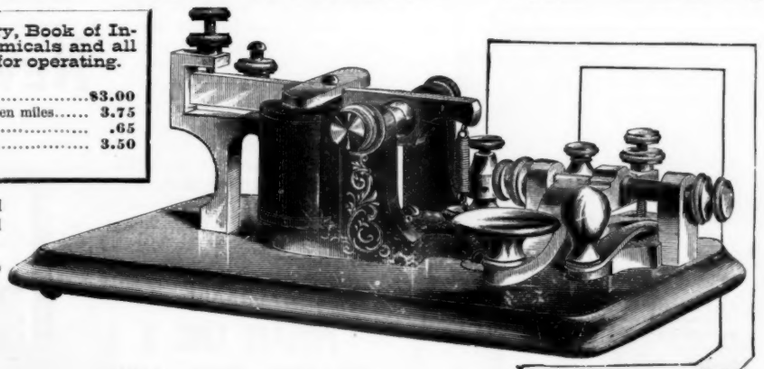

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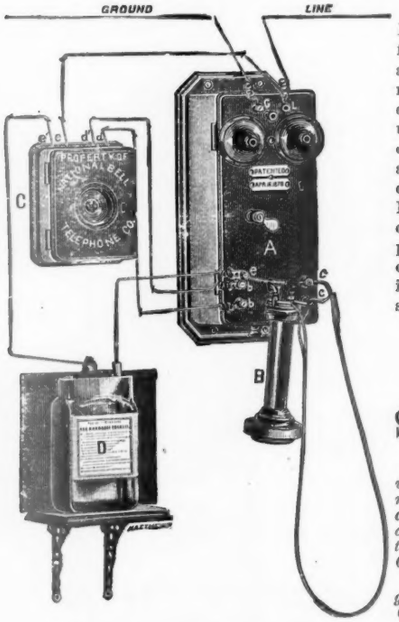


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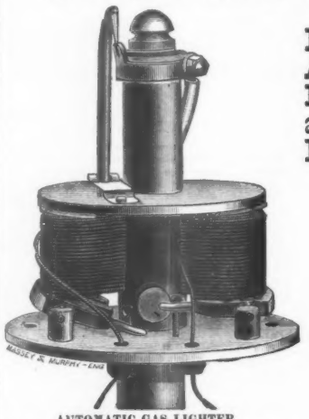
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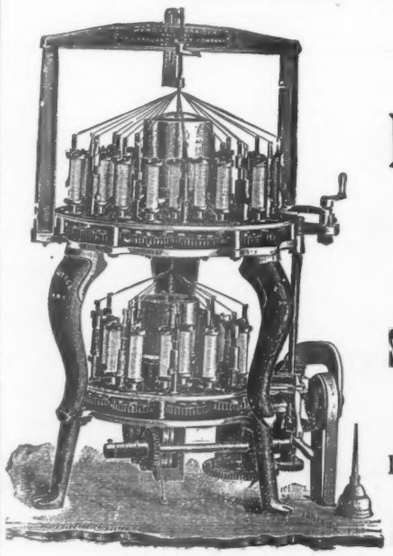

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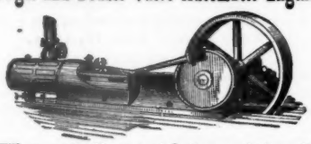

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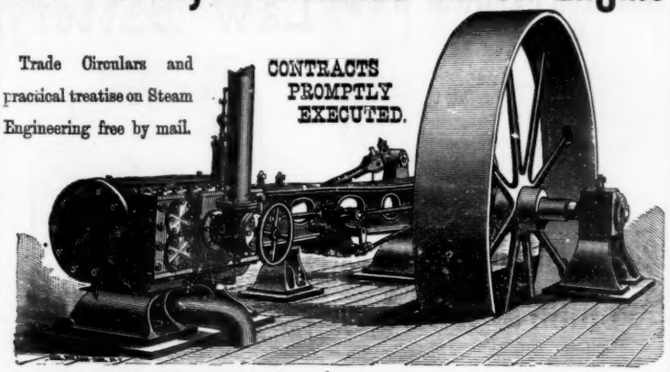

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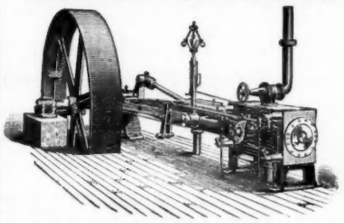

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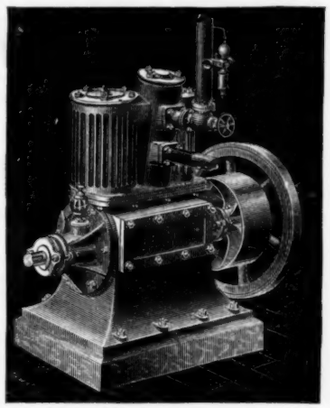

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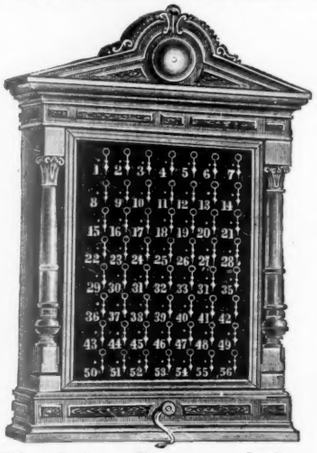

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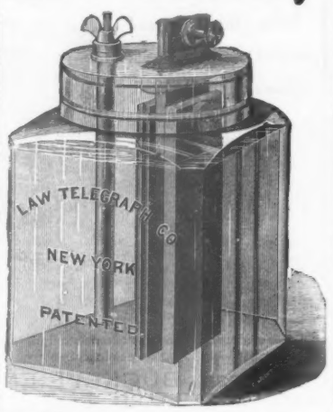


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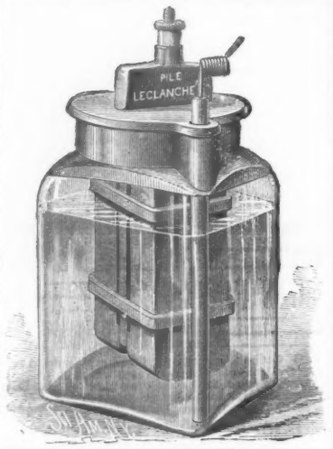


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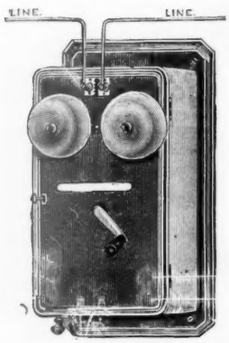


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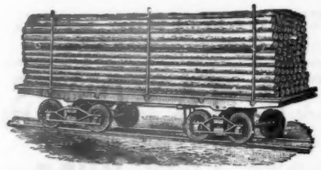

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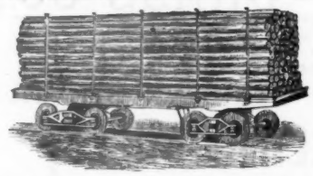

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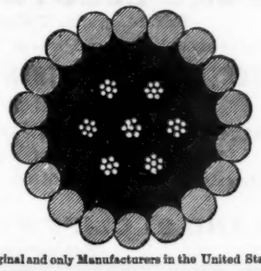

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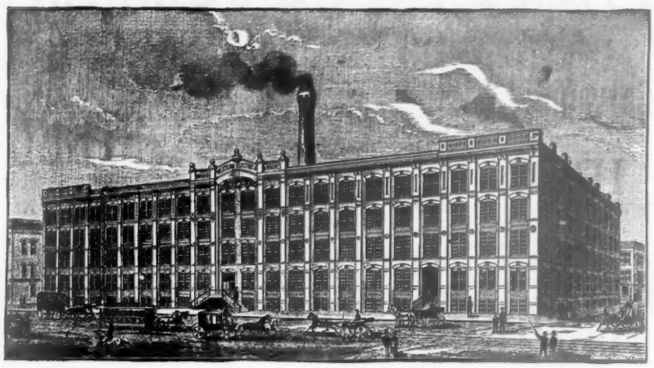

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